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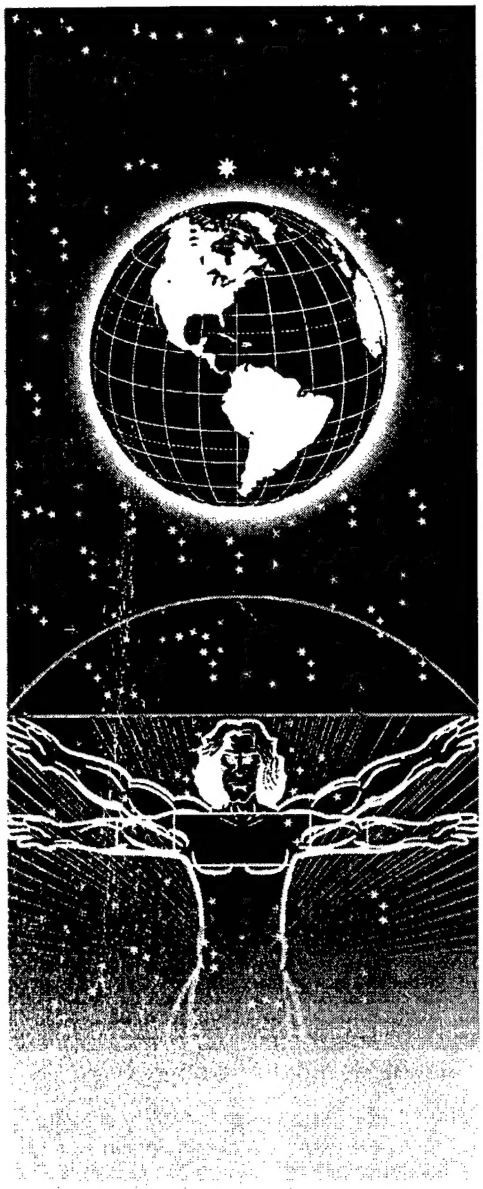

UNITED STATES AIR FORCE RESEARCH LABORATORY

AN INTEGRATED PRODUCT AND PROCESS DEVELOPMENT PROGRAM AND RELATED TRAINING REQUIREMENTS: FORMATIVE EVALUATION AND DEFINITION FOR AIR FORCE LABORATORY SCIENCE AND ENGINEERING PERSONNEL

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The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

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In recent years, the United States Department of Defense and, by extension, the Air Force have increased their emphasis on considerations of affordability in the weapons development cycle, particularly in the Science and Technology (S&T) phase. To help its members attain a better balance between performance, cost, and risk in their research and development efforts, the Air Force has encouraged the application of Integrated Process and Product Development (IPPD) principles. The approach involved selecting a group of pilot projects at several locations in the Air Force Research Laboratory (AFRL) system and providing a training program, Affordable Technology Through IPPD (AT/IPPD), to key members of those pilot projects. The Air Force Materiel Command (AFMC) also funded the present effort to provide a formative evaluation of that IPPD training program. The objectives of this research were to gather and analyze data related to the effectiveness of the AT/IPPD training program, determine the extent to which the training participants were able to implement the IPPD procedures in their projects, and identify obstacles to implementation of IPPD in S&T programs.

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PREFACE

This report documents a contract effort performed under Work Unit 1123-A3-23 (formerly 1123-C2-58), Formative Evaluation of Integrated Product and Process Development (IPPD). This research was conducted under Contract No. F41624-97-C-5012, with Metrica, Inc. to determine how current IPPD training courses can best be adapted in order to be suitable for Air Force Research Laboratory (AFRL) scientific and technology (S&T) efforts. The Laboratory Contract Monitor (LCM) was Ms Phyllis Morse; the LCM's Technical Representative was Dr Robert M. Yadrick (AFRL/HEA).

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AN INTEGRATED PRODUCT AND PROCESS DEVELOPMENT PROGRAM AND RELATED TRAINING REQUIREMENTS: FORMATIVE EVALUATION AND DEFINITION FOR AIR FORCE LABORATORY SCIENCE AND ENGINEERING PERSONNEL

INTRODUCTION

Each year government and private industry in the United States spend billions of dollars on training and development activities. Wooldridge, Baldwin, and Ford (as cited in Faerman & Ban, 1993) estimate that the federal government alone spends at least $6,333 million each year and that American industries spend up to $100 billion on training and development activities. Figures like these inevitably lead some to question whether this money is being well spent. This is a difficult question to answer for two reasons. First, there is surprisingly little systematic evaluation of training programs, in either government or the private sector, which actually tries to test the linkage between training and changes in work behavior. Second, the few attempts to study that linkage have failed to show positive changes in individual and organizational behavior.

Research that has focused on evaluating training outcomes often argues there is little evidence that the dollar spent on these training and development activities actually translate into changes in individuals' behavior on the job or improved organizational performance (Baldwin & Ford, 1988). Similarly, Newstrom (1986) argues that too much money and attention are spent on the design and delivery of programs and not enough on efforts to increase the transfer of training to the work environment. Over the past two decades organizations in both the government and private sectors have been asked to become more accountable and to justify the existence of programs in terms of cost and performance factors (Faerman & Ban, 1993). This has led to increased interest in the evaluation of training programs.

That training plays a crucial role in U.S. Air Force (USAF) effectiveness and efficiency is indisputable. For this reason the USAF dedicates a vast amount of people to the design and delivery of training. Moreover, the Air Force assigns individuals to evaluate training so that training decisions can be made based on the best available data. In fact, according to Thorndike (as cited in Alliger & Tannenbaum, 1996), a clear understanding of what kind of training is important for what jobs, and what factors influence training effectiveness has historically been an emphasis in the Air Force.

Background

In the past 20 years, the Air Force and other organizations have used large-scale education and training programs in attempts to bring about significant changes in organizational cultures, attitudes, and operating procedures. Experience with such high profile programs as Management By Objectives (MBO), multicultural/diversity awareness (including Equal Employment Opportunity [EEO] and sexual harassment training), and Total Quality Management (TQM) taught us that even the most elaborate and well -thought-out education and training efforts require tailoring and considerable support with an organization to bring about the intended outcomes. Lessons learned from these programs reinforce the need for well-planned evaluation and feedback mechanisms that will assess outcome achievement and facilitate timely program refinements.

Some of these lessons learned include:

- one size does not fit all,
- attitude is as important as technical skill,
- evaluation of outcomes from training cannot be limited to measurement of knowledge and skills attained at the end of the course,
- nontraining components need to be addressed to determine if obstacles within the job environment hindered effective application or use of principles,
- the "course" is never over, and
- the evaluation should be consistent with the spirit of the course.

These lessons were used to guide the development of ideas to include in the training evaluation surveys and interviews for this project.

Development and implementation of Science and Technology (S&T) Integrated Process and Product Development (IPPD) training is aimed at providing the Air Force S&T community with the knowledge, skills, ability, and motivation to support and adapt to changing customer requirements for technology transition. Air Force Materiel Command (AFMC) believes the IPPD process represents "an excellent method to systematically manage priorities, performance, cost and risk," and that learning to use this process will help S&T members operate more effectively in a changing technology transfer environment. Traditionally, however, real-world application of IPPD principles and methods were largely confined to commercial manufacturing settings. It was not clear how to adapt IPPD principles and methods to Air Force S&T projects, or whether IPPD principles and methods would prove to be equally applicable to or beneficial across a broad spectrum of differing types of Air Force S&T projects.

To help answer these questions, the Air Force Research Laboratory (AFRL) designed a test program to implement IPPD procedures in several 6.3 Advanced Technology Demonstration (ATD) projects in each of four Air Force research laboratories. They contracted with Texas Instruments Learning Institute (TILI) and James Gregory Associates to provide initial training and follow-up mentoring that would enable the project Integrated Product Teams (IPTs) to implement the IPPD procedures. The original training provided was a Design for Six Sigma Manufacturing (DSSM) course that TILI had used successfully to train IPPD processes in a manufacturing setting. Based on trainee feedback, this course was adapted into the Affordable Technology through IPPD (AT/IPPD) course, oriented more for the S&T community. Additionally, IPT members had the option of attending additional IPPD-related training courses, and experts experienced with applying IPPD in industrial settings were available for "mentoring" IPT members, regarding application of IPPD to their specific projects.

A systematic formative evaluation program, including feedback concerning the effectiveness when applying the IPPD initiative to Air Force S&T projects, was initiated to (a) indicate the extent to which pilot teams are able to effectively apply IPPD methods to S&T projects, and (b) describe how IPPD methods or training could best be adapted in order to be more effectively applied to S&T projects. Other issues, such as the role of ancillary training courses and mentoring interaction (e.g., which courses are/were most useful, to what extent did pilots use the mentoring opportunities, what effect did the mentoring have) were also addressed. As a formative evaluation, this research program was not designed to provide a definitive final statement of the utility of IPPD training and implementation. Rather, it was designed to provide both a review of the initial training experience and feedback concerning its utility in the IPPD pilot projects to date. Thus, training consultants and IPPD implementation managers have a basis for determining how to improve the entire IPPD educational experience and the support required in the S&T laboratory community to maximize its effectiveness.

Purpose of the Research

The Department of Defense is responsible for providing the most advanced warfighting capability at the most affordable cost. This responsibility is a constant but, in a time of budget decreases and downsizing, the scope of capabilities that can be provided to the warfighter is acutely dependent on controlling acquisition and life cycle cost. Attention to affordability must occur seamlessly throughout the weapons development cycle, particularly in the S&T phase where it has been traditionally neglected in favor of performance. Manufacturing and business processes developed in S&T must be sufficiently matured that they may transition to demonstration/validation, or engineering and manufacturing development without the need for costly reinvention in terms of both time and money (P.G. Kaminski, personal communication, August 7, 1996).

The affordability issue is a Department of Defense initiative. The Director, Defense Research and Engineering (DDR&E), chartered an S&T Affordability Task Force in May 1995 to address the issues of assessing and strengthening the affordability focus of military S&T programs. Findings from that task force identified a set of best practices for evaluating an S&T project with attention towards affordability, (i.e., does the project have exit criteria, have deliverables been clearly defined, is Integrated Product and Process Development being used, etc.). These criteria provide the basis for this affordability policy (P.G. Kaminski, personal communication, August 7, 1996).

One goal of this research effort was to develop and implement a formative evaluation program that would help determine the extent to which the AT/IPPD training program has facilitated employment of the IPPD process in the pilot IPTs that received that training. Other goals include identifying obstacles that mitigate against using IPPD procedures in the S&T community and providing observations in which that training and the climate for its use could be improved and lead to a more effective implementation of the DOD affordability policies.

Specific objectives related to these goals were as follows:

1. Gather and analyze data regarding the effectiveness of the IPPD training program for Air Force S&T pilot project personnel.

2. Identify obstacles to successful implementation of the IPPD initiative in Air Force laboratories, including problems or deficiencies in the training program, inherent incompatibilities between the IPPD concept and the nature of Air Force laboratory work and projects, and such "cultural" obstacles as lack of management support for the initiative or lack of acceptance of IPPD principles by project personnel.

3. Compare projects from within the same laboratory and across different laboratories to identify differing implementation processes or obstacles that result across project types or laboratory environments.

4. Assess the potential for employing alternative means of delivery such as computer-aided instruction or distance learning techniques.

5. Provide recommendations concerning instruments and methods for a long-term program evaluation effort.

The criteria for assuring a focus on affordability in S&T are that:

- customer needs are understood,
- management is willing and able to support IPPD,
- program strategy addresses critical affordability issues,
- affordability metrics have been established and are being measured, and
- a training plan has been developed and executed.

METHODOLOGY

The Research Plan

The general research plan involved two related data collection efforts. First, researchers would observe the AT/IPPD training sessions, gather feedback through discussions with participants and an end-of-course questionnaire, and provide the training team with interim summaries of participant responses and recommendations for improving course content or delivery. These data were designed to determine the participants' perceptions of their entering knowledge of and attitude about the IPPD process and the extent to which their understanding and attitude changed by the end of the three-day training session.

The second, more difficult data collection effort, involved gathering follow-up information from IPT members who had taken IPPD training at least six months previously, about the extent to which they were able to implement those procedures in their pilot projects. Data collection required visits to several AFRL laboratories and using small group and/or telephone interviews. Questionnaires were also used to obtain feedback from those interviewed and from team members who had participated in training but were not available for the interview sessions. In conjunction with the evaluation project's government program monitor (GPM), researchers agreed to gather data from members of several IPTs who had not taken the AT/IPPD course, but who had participated in the DSSM training course at TILI between May and November 1996. That course had served as a basis for the eventual AT/IPPD course, which was presented over seven sessions between April and October 1997. Table 1 is a summary of the 13 IPTs and the numbers who had attended either the DSSM or IPPD course. The total of 56 DSSM participants reflects four individuals who attended both the DSSM course in 1996 and an AT/IPPD session in 1997.

In addition, discussions with pilot members at the first training sessions led to the realization that it would be difficult, in the time allotted in the original contract, to assess the implementation of IPPD among those pilots whose members took the training after June 1997. There would not be sufficient time for some of those pilots to employ the IPPD procedures by the time data gathering would have to be completed in November 1997. Therefore, the GPM and the researchers agreed to a six-month, no-cost extension of the contract so data could be gathered through March 1998 and more of the pilot teams could be included.

Because the subject sample, data collection devices and the purpose of the two phases of the research effort are different, the phases will be dealt with separately throughout the Methodology and Results sections of this report. In each section, the information pertaining to the immediate impact of the AT/IPPD training course will be provided. Then, the information related to the actual implementation of the IPPD process in the various pilot programs will be presented.

Table 1. DSSM/IPPD Training Session Participants by Pilot Project

PILOT PROJECT	NUMBER OF PARTICIPANTS	
	DSSM	IPPD
3-D Optical Computer Memory Storage (3D-OP)		9
Advanced Motor Drive (AMD)	3	
Advanced Laser Eye Protection (ALEP)		25
Composite Affordability Initiative (CAI)		29
Large Aircraft Infrared Countermeasures (IRCM)	15	
Integrated Space Technology Demonstration (ISTD)		6
Improved Space Computer Program (ISCP)	5	
Low Cost Autonomous Attack System (LCAAS)		1
Modular Aircraft Support System (MASS)	1*	7
Next Generation Transparency (NGT)	20*	7
Over The Horizon Technologies (OTH)		7
Virtual Interactive Intelligent Tutoring System Development Shell VIVIDS)		7
Ballistic Winds Airdrop (WINDS)	12	3
TOTAL	**56***	**101**

* 4 members attended both DSSM and AT/IPPD training

Analysis of the AT/IPPD Training Sessions

Data Collection Instrument/Methods. Project researchers attended all seven of the AT/IPPD training sessions. Because the research contract did not begin until May 1997, the GPM attended the first trial session of the new course in April, which had only five participants, and only three from an IPT. He administered a preliminary 42-item questionnaire that served as the basis for the instrument used in the other six sessions. The questionnaires administered to the participants of the other six training sessions contained 54 items and subitems and differed primarily by the anchoring of intermediate points in a few of the scales and by addition of seven questions asking about potential obstacles to implementation of the IPPD process in their projects. While a majority of the questions had respondents select from a 5-point modified Likert scale, several demographic questions required selection from a short list of options. A number of questions related to the course content offered open-ended opportunities for comment or recommendations. A sample of this questionnaire is found in Appendix A.

Table 2. Number Responding to IPPD Training Session Evaluation Questionnaire by Pilot Project.

PILOT PROJECT TITLE	RESPONDENTS
3-D Optical Computer Memory Storage (3D-OP)	9
Advanced Laser Eye Protection (ALEP)	25
Composite Affordability Initiative (CAI)	29
Integrated Space Technology Demonstration (ISTD)	5
Low Cost Autonomous Attack System (LCAAS)	1
Modular Aircraft Support System (MASS)	7
Next Generation Transparency (NGT)	7
Over The Horizon Technologies (OTH)	7
Virtual Interactive Intelligent Tutoring System Development Shell (VIVIDS)	7
Ballistic Winds Airdrop (WINDS)	3
TOTAL	**100**

Subject Sample. Of 116 participants in the seven IPPD training sessions, 102 were associated with one of the 10 IPTs represented at those sessions. Questionnaire responses were received from 100 of those participants (Table 2), representing both government and contractor personnel, and ranging across a number of project positions (see Tables 3 and 4). Because a larger number of participants were from two of the pilot projects, researchers continuously compared their responses to those of other pilots to determine if their input skewed the overall results.

Table 3. IPPD Training Session Questionnaire Respondents by Organization

ORGANIZATION	RESPONDENTS
Armstrong Laboratory	12
Philips Laboratory	7
Rome Laboratory	12
Wright Laboratory	13
AD Little	3
Anteon	2
Boeing	11
Call/Recall	1
Command Technology	1
Coherent Technology	3
Dalloz Safety	2
GE Aircraft	1
KOSI	2
LAE	1
Lockheed	4
MANTECH	1
MTC	1
NAVAIR	5
Northrop	3
Pilkington OP	1
Rockwell	1
Synectics	1
TASC	8
USC	1
TOTAL	**100**

Table 4. IPPD Training Session Questionnaire Respondents by Position.

POSITION	RESPONDENTS
Administrative Manager	4
Administrative Supervisor	1
Budget Manager	1
Consultant	2
Cost Analyst	3
Engineer	18
Integrated Product Team Leader	3
Program Manager	5
Researcher	8
Scientist	3
Technical Assistant	1
Technical Manager	37
Technical Monitor	2
Technical Specialist	1
Technical Supervisor	7
TOTAL	**100**

Data Analysis. The questionnaire data were, initially, entered into Excel spreadsheets. The completed database was then saved as a flat-text file. The flat file was imported into the Stata statistical package which was used to conduct all the statistical processing and analyses (StataCorp, 1997). The write-in comments from each questionnaire were summarized on a spreadsheet for qualitative analysis to determine patterns of responses.

Analysis of the Implementation of IPPD Procedures in the IPT Pilots

Data Collection Instruments/Methods. Information regarding the trainees' ability to actually implement the IPPD process in their pilot projects was gathered through two methods. First, structured interviews were undertaken with the program managers and, where possible, key members of the IPTs at least six months after they had participated in the IPPD training. This was the minimal amount of time that was considered necessary to enable the teams to show any progress in the use of IPPD procedures. The interview items were developed from discussions with IPT members at the training sessions and were tested and refined at a preliminary session at Wright Laboratory in August. The list of interview session discussion questions is found in Appendix B.

In addition to structured interviews, we gathered additional supportive information via a Follow-up Questionnaire administered to each of the interview session participants and mailed to members of the IPT that had attended IPPD or DSSM training but were not available for interviews. This questionnaire once again was developed based on discussions with IPT members at the training sessions, with IPPD program managers at AFMC, and with the training consultants. It was pilot tested among several IPT members at Brooks AFB and was refined to insure adequate coverage of issues as well as ease of understanding by participants. The instrument consisted of 62 items or subitems and included a few demographic description questions, 46 questions employing a 5-point Likert scale, and a few open-ended questions allowing for write-in comments. A number of the questions were similar to those on the training session questionnaire (e.g., regarding participants' knowledge of and ability to apply IPPD, obstacles to implementation, and perceptions of management knowledge and attitude about IPPD). However, these were intended to get a picture of IPT members' impressions after they had been back on their projects and had had a chance to implement the IPPD procedures in a work environment. Additional questions focused on the extent to which individuals and IPT teams have actually employed various IPPD processes in their work efforts and the extent to which use of IPPD methods seemed to help the projects. A sample of the Follow-up Questionnaire is found in Appendix C.

Finally, it became apparent from the group interviews in November 1997 that the IPPD implementation was an ongoing process and that additional application would occur in several projects in the four months (December 1997 through March 1998) after the initial interview and Follow-up Questionnaire data were gathered. In an effort to provide the most current data, follow-up telephone and personal interview sessions were conducted in late March and April with program managers from nine pilots contacted earlier and with two pilots that had taken the IPPD course in August and September 1997. At the same time, to provide a more common metric for updating and summarizing the status of the pilots, program managers filled out a short Summary of IPPD Processes Used survey. This instrument asked them to describe their project's experience with each of six aspects of the IPPD process by selecting from a series of descriptive choices derived from the researchers' previous data gathering. A copy of that survey is found in Appendix D.

Subject Sample. Of the 13 IPT projects initially intended as IPPD pilots, two encountered unforeseen difficulties that precluded their continuation as pilots. The Low Cost Autonomous Attack System project was delayed, and only one member participated in the IPPD training. The Integrated Space Technology Demonstration program was unable to continue as an IPPD pilot because of contractual difficulties. Little evaluative information was obtained from these two projects, and researchers decided to include only the results of the other 11 pilots.

Researchers made follow-on visits to AFRL sites at Wright Patterson AFB in Ohio; Rome Laboratory, New York; and Brooks AFB, Texas, where they interviewed 59 team members in small groups from 10 of the 13 original IPTs. Telephone interviews were employed with the program manager of the ISCP project at Kirtland AFB, and limited telephone contact was made with representatives of two of the IPTs whose participation as IPPD pilots was interrupted by unforeseen circumstances. A summary of the IPTs teams interviewed is at Table 5.

Follow-up Questionnaires were administered to IPT members who attended the IPPD or earlier DSSM training sessions. They were distributed either at the interview sessions, through program managers, or mailed directly to the subjects at their work sites after they had first been notified by their program managers. After three weeks, follow-up appeals were sent to nonrespondents either by the program representatives or directly through electronic or telephone messages. Of the original 154 IPPD or DSSM training participants, 27 were not included in the administration because they were no longer associated with the pilot project. Overall return rate was 68 %; the rate was above 65% for 8 of the 11 IPTs that received questionnaires. Table 5 summarizes the questionnaires sent and subjects responding.

Table 5. Members Participating in IPPD Follow-up Data Gathering by IPT

PILOT PROJECTS	INTERVIEWS	QUESTIONNAIRES SENT/RESPONSES
3-D Optical Computer Memory Storage (3D-OP)	6	9/6
Advanced Motor Drive (AMD)	2	3/3
Advanced Laser Eye Protection (ALEP)	12	24/16
Composite Affordability Initiative (CAI)	6	29/16
Large Aircraft Infrared Countermeasures (IRCM)	12	14/11
Improved Space Computer Program (ISCP)	1	5/3
Modular Aircraft Support System (MASS)	3	7/5
Next Generation Transparency (NGT)	4	14/9
Over The Horizon Technologies (OTH)	6	7/6
Virtual Interactive Intelligent Tutoring System Development Shell (VIVIDS)	5	7/5
Ballistic Winds Airdrop (WINDS)	3	8/4
TOTAL	**60**	**127/86**

Data Analysis. As with the post-training questionnaire data, the Follow-up Questionnaire data were also entered into Excel spreadsheets and then saved as a flat-text file. The flat file was imported into the STATA statistical package that was used to conduct all the statistical processing and analysis. Write-in comments from each questionnaire were copied and summarized on a spreadsheet for qualitative analysis to determine patterns of responses. The interview notes were summarized after each session and were reviewed with the program managers to ensure there was no confusion regarding terminology or status/direction of the projects. Researchers compared the project summary impressions with questionnaire responses for the IPTs to obtain a more complete analysis of the IPPD implementation situation.

RESULTS

AT/IPPD Training Sessions

Perceptions of General IPPD Knowledge/Understanding. The majority (51%) of the participants reported entering the course with none to a small amount of IPPD experience, while only 23% indicated having a large to very large amount of IPPD experience. However, two pilot teams reported having a much greater amount of IPPD experience. As one of them had a large number of respondents, that pilot's responses somewhat skewed the results to that item. If that pilot's responses had been normalized to reflect the size of most other groups, the number reporting none or a small amount of experience would have been 61%, rather than 51%. Across the general results from the training participants' questionnaire, this was the only area in which the responses from one of the two large pilot groups affected the overall results by more than 9 percentage points. The by-pilot breakout of responses to this and many other items are found in Appendix E.

With regard to prior IPPD knowledge, initially 58% indicated they entered training with none to a small amount of knowledge. After the training, the percentage indicating they presently have none to a small amount of knowledge dropped dramatically to 8% (see Table 6).

Table 6. Percentage of Respondents Reporting Various Amounts of IPPD Experience and Knowledge

PRIOR IPPD EXPERIENCE		
NONE TO SMALL	MODERATE	LARGE TO VERY LARGE
51%	26%	23%
PRIOR IPPD KNOWLEDGE		
NONE TO SMALL	MODERATE	LARGE TO VERY LARGE
58%	28%	14%
IPPD KNOWLEDGE AFTER TRAINING		
SMALL	MODERATE	LARGE TO VERY LARGE
8%	51%	41%

Fairly encouraging changes were indicated in perceived understanding of IPPD initiative, benefits, and application following course completion. In terms of prior understanding of the IPPD initiative, 25% reported good or excellent understanding of reasons for initiative--that percentage increased to 64% after training. With regard to IPPD benefits, 24% reported entering training with good or excellent understanding; this percentage increased to 60% after training. Furthermore, while 69% reported none to slight understanding of the IPPD application to projects, that percentage dropped to 19% upon completion of training (see Table 7).

Perceptions of Ability to Apply IPPD Procedures. Relatively few reported strong confidence in their overall ability to apply training after the initial IPPD course. While 29% said they were capable or very capable, 46% said they were only moderately capable, and 25% said they were slightly capable or not at all. Additionally, the majority of respondents (54%) reported they needed at least a moderate amount of additional training, while 28% said they needed a large or very large amount of additional training (see Figures 1 and 2).

Table 7. Percentage of Respondents Reporting Amount of IPPD Understanding Before and After IPPD Training

	UNDERSTANDING INITIATIVE		
	NONE TO SLIGHT	MODERATE	GOOD TO EXCELLENT
PRIOR	50%	25%	25%
POST TRAINING	4%	32%	64%
	UNDERSTANDING BENEFITS		
	NONE TO SLIGHT	MODERATE	GOOD TO EXCELLENT
PRIOR	56%	20%	24%
POST TRAINING	5%	34%	60%
	UNDERSTANDING APPLICATION		
	NONE TO SLIGHT	MODERATE	GOOD TO EXCELLENT
PRIOR	69%	21%	10%
POST TRAINING	19%	41%	40%

Attitudes about Potential Application and Utility of IPPD. There were some changes in projections for success of IPPD, although a fairly large group of doubters were still represented. Originally, only 19% believed their ability to successfully apply IPPD to their project was likely or highly likely, but after training, that percentage increased to 43%. However, after training, 17% reported it was unlikely or highly unlikely that they could successfully apply the IPPD techniques to their projects (see Figures 3 and 4).

With regard to IPPD providing real benefits to their pilot projects, 18% originally reported IPPD was likely to provide real benefits, but after training, 40% of respondents reported that IPPD was likely or highly likely to provide real benefits to their projects. After training, only 16% believed it was unlikely or highly unlikely that IPPD would provide real benefits (see Figures 5 and 6).

Respondents reported fairly strong perceptions of general utility of the IPPD process and training beyond their current pilot project. The respondents' opinions were split with regard to IPPD having benefits for other 6.3 S&T projects--48% perceived moderate benefit to other projects, while 48% saw large or very large benefits to using the IPPD process. In terms of the IPPD process being useful for future professional development, 30% said the IPPD process was moderately useful, but 61% perceived the process as quite or extremely useful (see Figures 7 and 8).

Perceptions of Management's Understanding of/Belief in IPPD. Relatively few respondents perceived a large amount of knowledge or faith in the IPPD process among management. In terms of management's knowledge of the IPPD process, 8% perceived their knowledge was large or very large; however, 57% said none or small, and 7% didn't know. When asked about their management's understanding of reasons for IPPD, 21% indicated their understanding was good or excellent; however, 46% said none or slight, and 8% didn't know. The results were similar with regard to management's understanding of IPPD benefits--21% reported perceiving their understanding as good or excellent, but again, 43% said none or slight, and 9% didn't know (see Figures 9, 10, and 11).

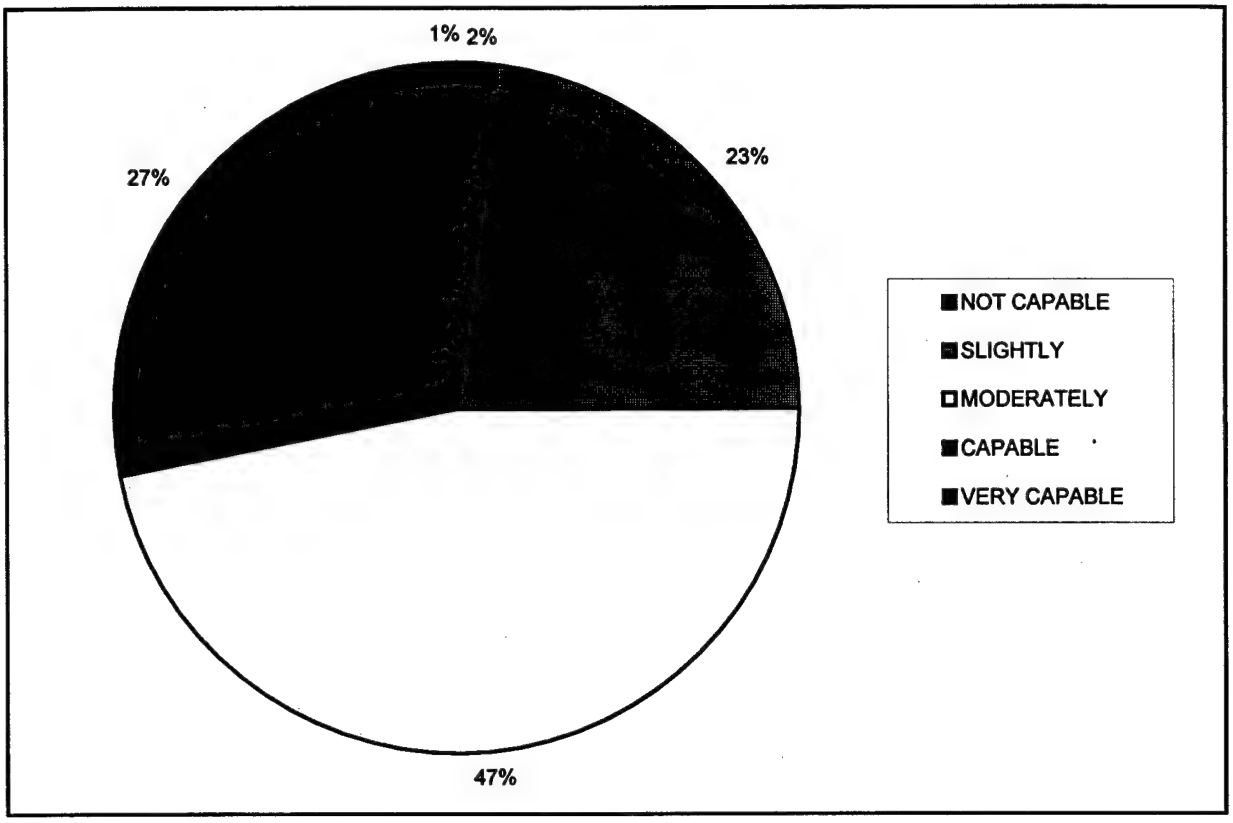

Figure 1. Capability of IPPD Application after Training.

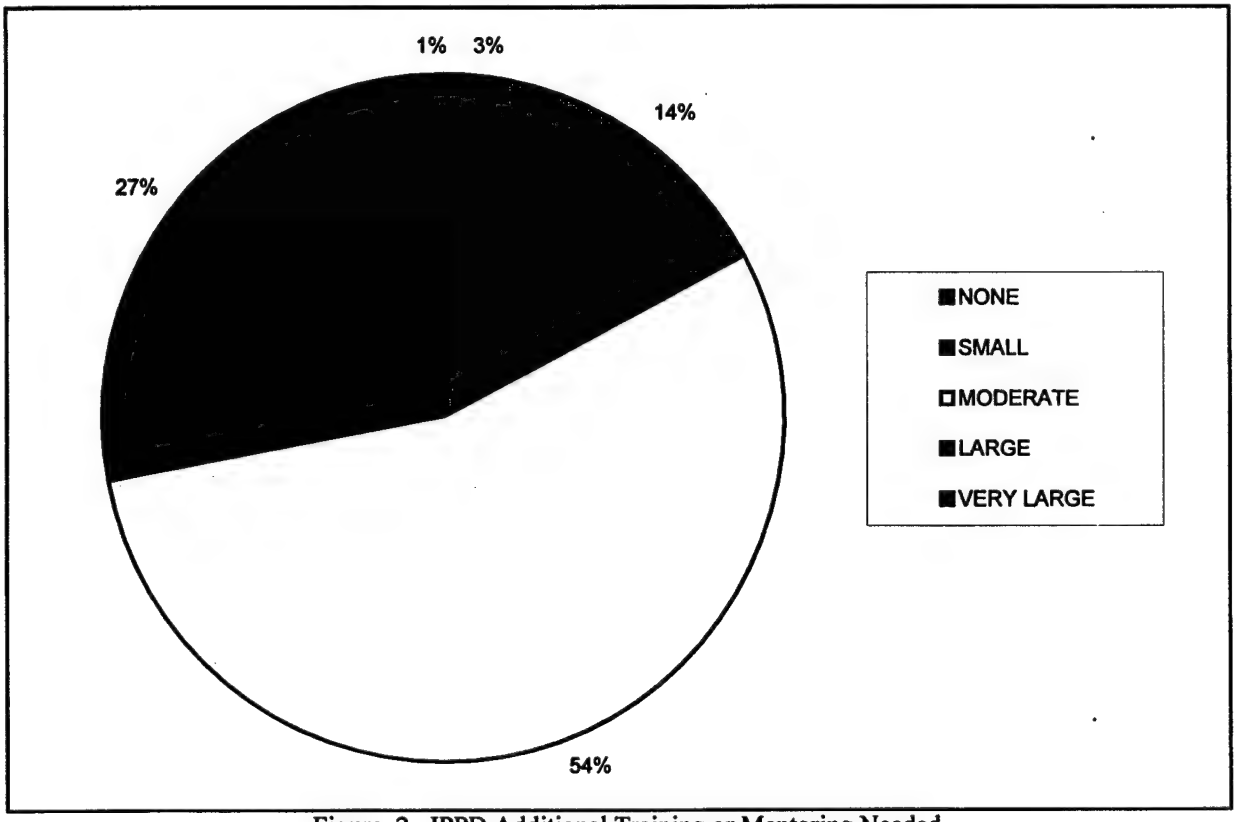

Figure 2. IPPD Additional Training or Mentoring Needed

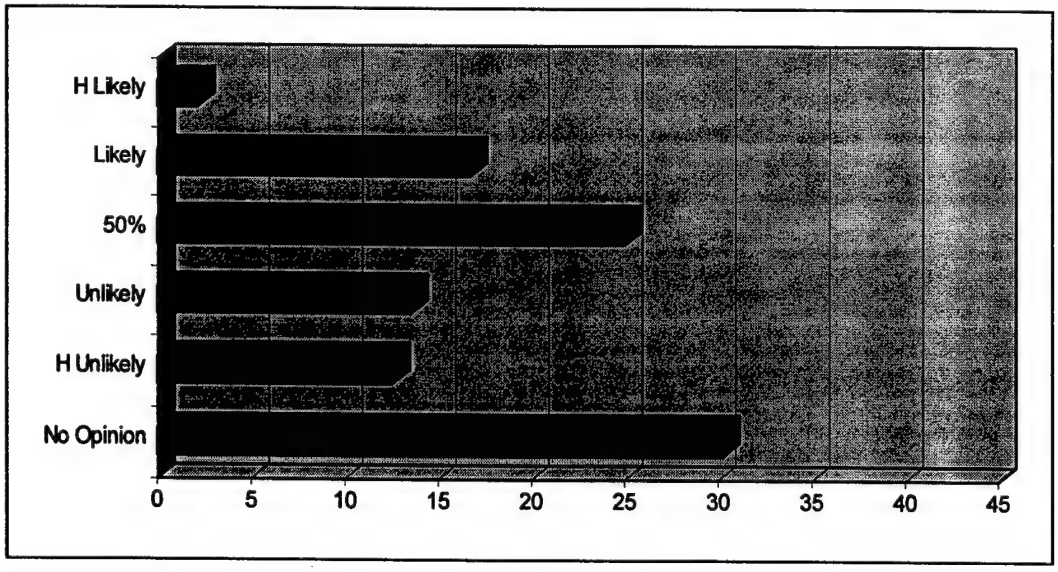

Figure 3. Prior Projections about Successful IPPD Application

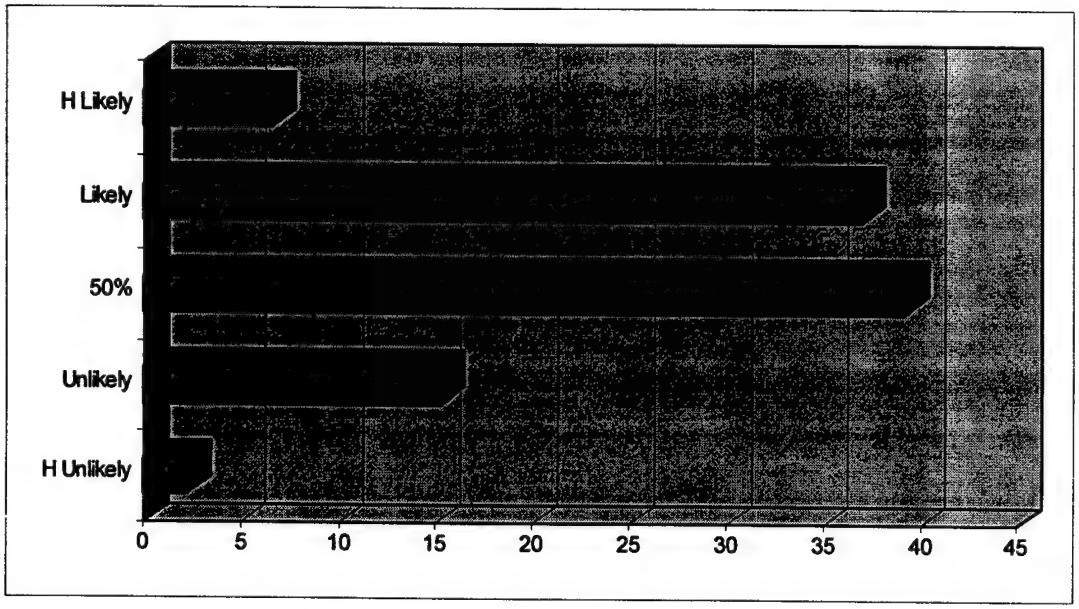

Figure 4. Post-training Projections about Successful IPPD Application

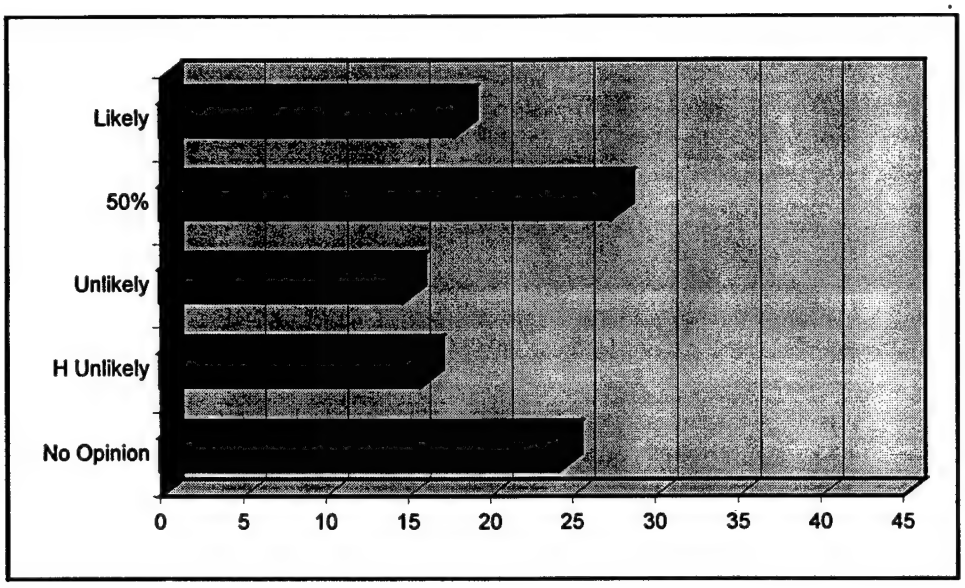

Figure 5. Prior Projections about IPPD Achieving Real Benefits

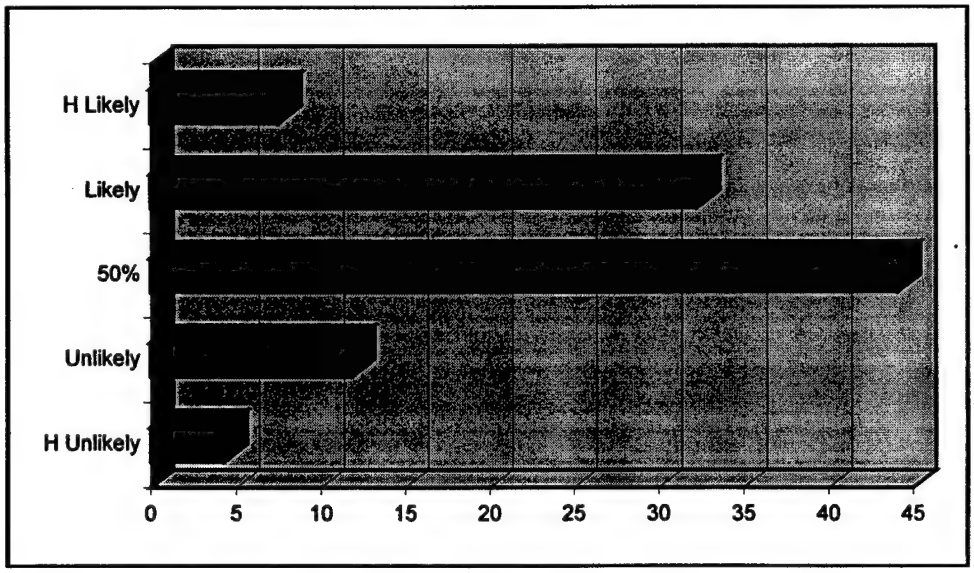

Figure 6. Post-training Projections about IPPD Achieving Real Benefits

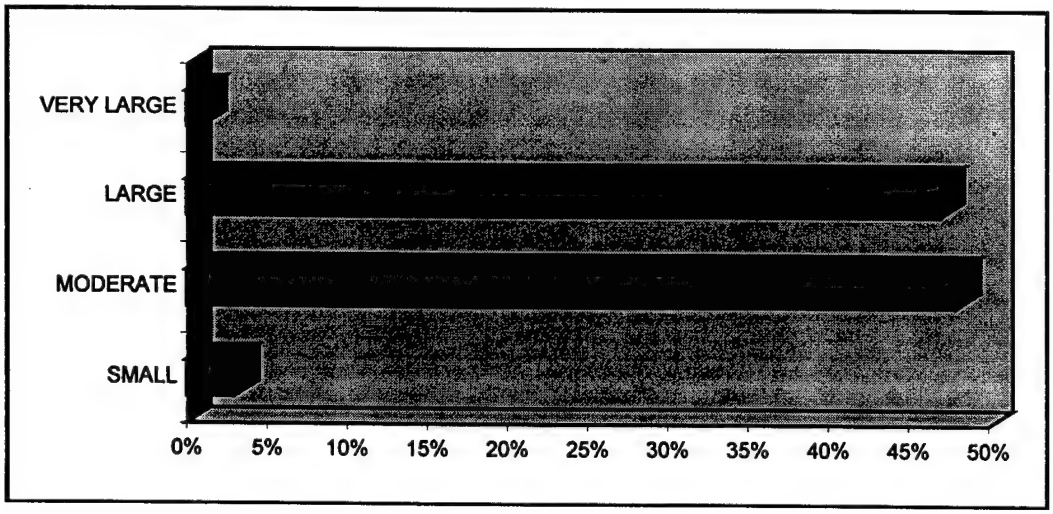

Figure 7. IPPD Benefits to Other Projects

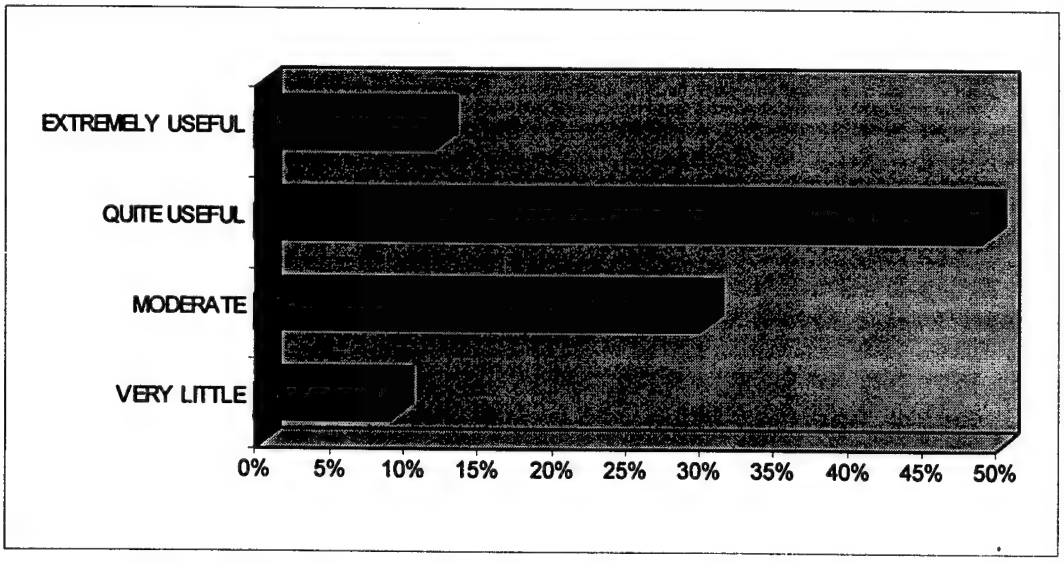

Figure 8. Usefulness of IPPD to Personal/Professional Development

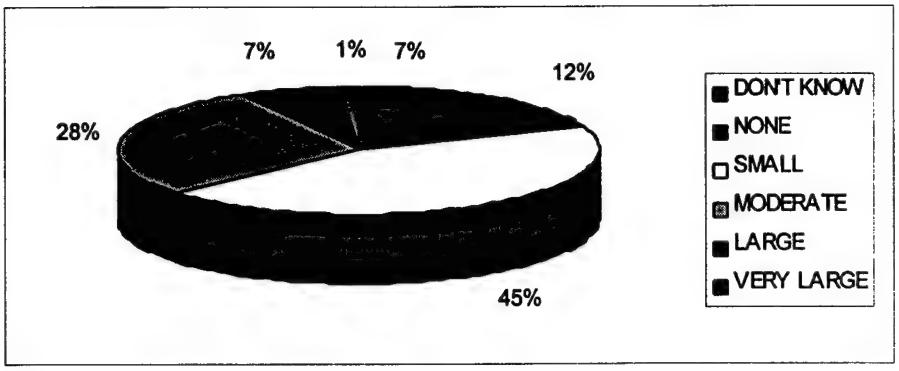

Figure 9. Perception of Management's Knowledge of IPPD Process

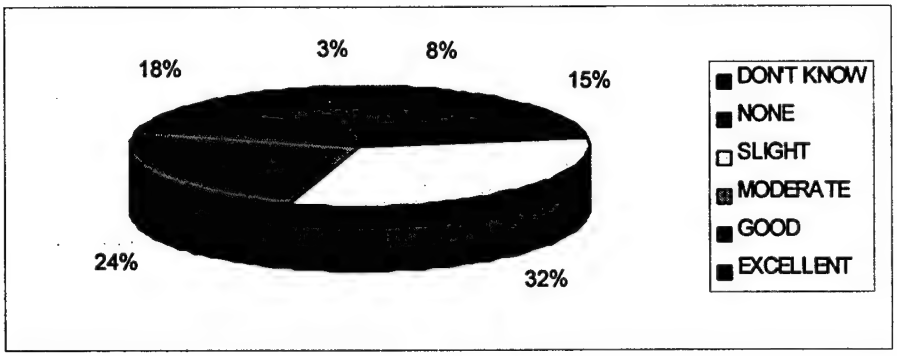

Figure 10. Perception of Management's Understanding of IPPD Initiative

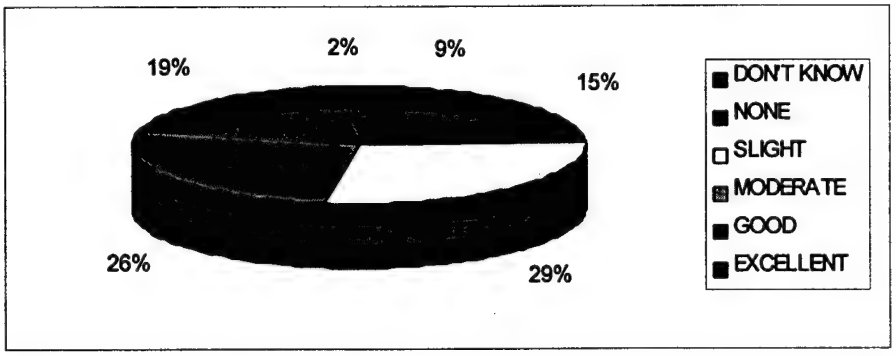

Figure 11. Perception of Management's Understanding of IPPD Benefits

Continuing the trend, respondents reported similar results for their management's understanding of IPPD application to their pilot projects (13% said good or excellent; 58% said none or slight; 13% didn't know); their management's projections for successful application (20% said likely or highly likely, 18% indicated unlikely or highly unlikely, and 32% didn't know); as well as their management's projections for the IPPD process resulting in actual benefits (17% indicated likely or highly likely, 17% also indicated unlikely or highly unlikely, and 34% didn't know). (See Figures 12, 13, and 14)

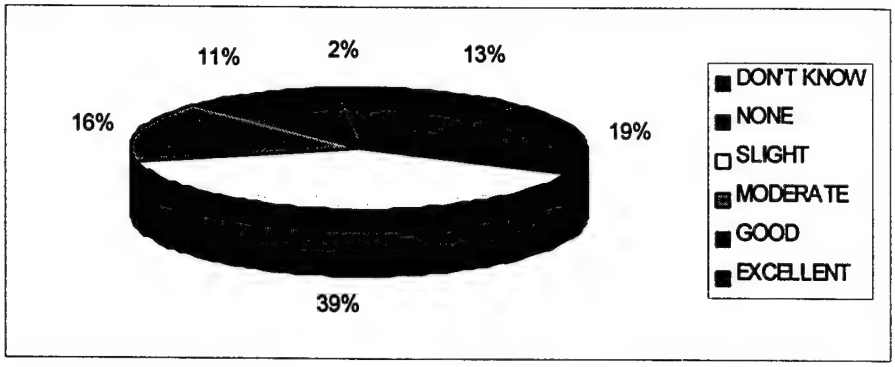

Figure 12. Perception of Management's Understanding of IPPD Application

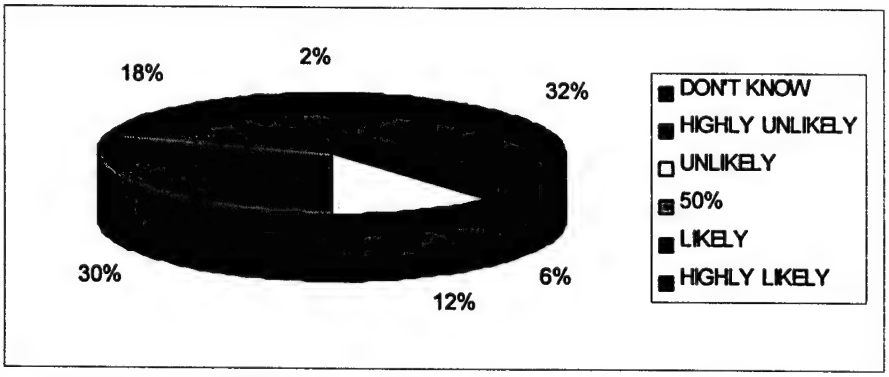

Figure 13. Perception of Management's Projections about Successful IPPD Application

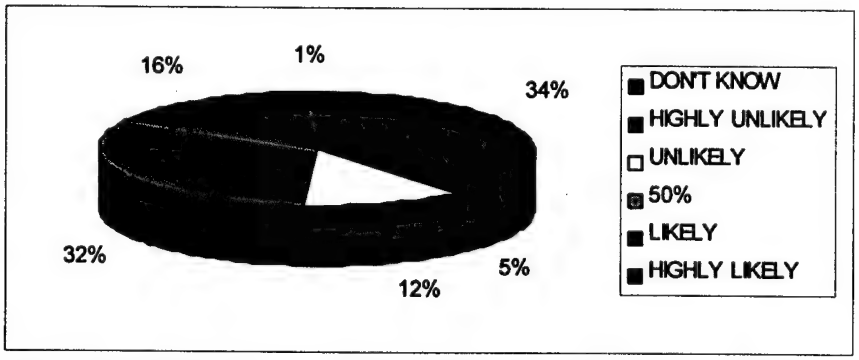

Figure 14. Perception of Management's Projections about IPPD Achieving Real Benefits

Perceptions of management knowledge and understanding tend to be fairly consistent among the pilot groups. When compared across nine of the pilot projects that had more than one attendee, the responses to the knowledge and understanding questions generally reveal seven or eight projects with less than 25% of the respondents indicating a good to excellent understanding on the part of management. However, one group consistently reported greater understanding on the part of their management, with between 43% and 57% indicating a large to very large knowledge or good to excellent understanding.

There was somewhat less consistency among the pilots when they described their perceptions of management's projections for the likelihood of successfully applying IPPD or of obtaining benefits from that application. For these two questions, more than 40% of respondents in at least four of the groups didn't know what their management's projections were. In seven or eight of the pilot groups fewer than 33% of respondents reported that their management perceives IPPD success or benefits to be likely or highly likely. Once again, there is that same group with 57% reporting management expects that successful IPPD application is likely or highly likely. And there are two groups in which 43% indicate their management thinks it is likely or highly likely that benefits will accrue from IPPD application.

Perceptions of Potential Obstacles to Implementation. Based on discussions with IPT members and training consultants, several factors consistently identified as hindrances to IPPD implementation were listed in the questionnaire. Having just completed the training, respondents were asked to use a 5-point scale and rate the amount that each factor might play in preventing successful application of IPPD in their project. The factor identified most consistently as a potential obstacle was the unknown or changing variables or conditions associated with their project that prevented estimation of reliable parameters. In six of the nine pilot projects responding, more than 40% of eligible respondents indicated this aspect would play a large or very large part in hindering application of IPPD. Table 8 shows the prevention impact percentages for all four factors, by pilot group.

Table 8. Percent, by Pilot, Indicating Various Factors Hindered Their IPPD Implementation a Large or Very Large Amount

	PILOT TEAMS								
Hindering Factors	1	2	3	4	5	6	7	8	9
Too many unknown or changing variables	67	40	65	0	100	43	0	43	29
Project has special needs/qualities not to IPPD	33	16	41	40	0	0	0	86	0
Too far along in project to employ	11	0	3	20	0	0	0	86	14
Not enough time/Resources	33	40	7	20	0	0	0	43	14
Other	0	36	29	60	0	14	14	14	57

In addition, 49 respondents identified factors other than those listed and indicated they could have a significant impact on the ability to implement IPPD. In two of the ten IPTs, more than 40% of the eligible respondents indicated "other" factors would hinder implementation a large or very large amount. The most common of those additional factors were insufficient time, lack of funding for IPPD costs, management commitment to IPPD, difficulty in obtaining user involvement, needed practice in using IPPD methods, and potential budget cuts.

Perceptions of Course Content and Suggestions for Improving the Course. It is evident that participants saw personal benefits from the course material, since as shown in Figure 8, 60% indicated it is quite or extremely useful for their professional development. These respondents also saw ways in which the material could be changed to better prepare them for IPPD implementation in their specific IPT project. Write-in responses to open-ended questions about the content and conduct of the IPPD course echoed many of the perceptions expressed to researchers during the various sessions and provided excellent feedback for course improvement. A short summary of the responses to each of these questions follows.

1. Course Content Most Useful or Relevant: When asked to identify the block of instruction they perceived as most useful or relevant, 94 of the participants provided a response, and 77 of those listed reasons for their selection. A large majority of respondents (74) indicated that either the House of Quality (39) or Design of Experiments (35) modules were most useful. The sessions on Monte Carlo Technique, Equation-Based Analysis, and Value Scorecards were cited a total of 8, 7, and 5 times respectively.

The reasons offered for usefulness or relevance varied. Respondents citing the House of Quality as most useful indicated this technique allows identification of customer and engineering requirements up front, and they explained that it forces the user to be more organized, gathering only useful data, related to requirements. Those citing the Design of Experiments as most useful reported that technique allows the user the capability of statistically sorting and evaluating critical requirements based on defined requirements and tolerance. They indicated that the IPPD system provides the opportunity to effectively rate different solutions and to allow outside evaluations of pending decisions. A few respondents reiterated that the above techniques would be applied to their individual pilot projects.

2. Course Content Least Useful or Relevant: Fewer (69) of the respondents offered comments about their least favorite blocks of instruction--and these were more widely varied. Ten of the respondents cited the Unmanned Research Vehicle exercise as the least useful portion of the course, indicating there wasn't enough time to complete the different parts of the exercise, that too much time was spent "number crunching," or, most commonly, that the exercise related more to production or manufacturing processes and not to S&T. Other modules cited as least useful or relevant were as follows:

- Design of Experiments (8 times)
- Equation-Based Analysis (6 times)
- Monte Carlo (6 times)
- Expert Judgement (3 times)
- House of Quality (2 times)

A common concern (of those who cited a least useful block) was that the mathematical demands of the course were either too confusing, presented in too much detail, or not relevant to the overall understanding of the IPPD process. Several comments indicated the material was too complex/particular for the audience (i.e., program managers don't have to be statisticians to manage programs using IPPD). Forty respondents provided suggestions to make these sections more useful and included the following:

- increase the course time allotted or decrease the URV exercise and mathematical requirements
- provide software to assist with different module tasks, rather than making everyone crunch the numbers manually
- tailor the course modules more to the specific pilot projects or more effectively show the application of the principles to 6.3 S&T activities

3. Suggestions for Improving the Course: The last two items on the questionnaire asked respondents if they would make any other changes to the course content or conduct and solicited specific suggestions. Responses from 71 participants were varied, but echoed many of the earlier suggestions.

- better organize or execute the course exercise; the idea was good, but the execution and instructions left some work teams confused
- develop an exercise more in line with pilot projects
- show better application of the process and techniques to 6.3 S&T activities
- spend less time on mathematics or provide teams with a computer and spreadsheet software to do the math so more time could be spent thinking about the results
- provide correctly prepared worksheets for students to take away with them
- provide text materials ahead of the class so students can read prior to attending
- put more emphasis and examples on the availability of data in the prototype environment
- address how findings from analyses are to be reported to management, who sometimes feel uncomfortable with too much statistical detail

As this research project was a formative evaluation, feedback from the Post-training Questionnaire and the evaluators' observations of the training sessions was provided periodically to the training consultants so they could make adjustments in their content or delivery.

Implementation of IPPD in IPT Pilots

In this section, information from the small group and telephone interview sessions and from the IPPD Process Summary Survey are used in conjunction with the quantitative responses and write-in comments from the Follow-up Questionnaire. Results and attendant discussion generated from all these data collection efforts will help illustrate the extent to which the DSSM and AT/IPPD training participants were able to employ the skills and knowledge of the IPPD process and procedures in their pilot projects. This summary of results will focus on the respondents' perceptions of

1. the amount of IPPD skill and knowledge they possess and its sufficiency for applying IPPD in their project;

2. the extent they, individually, and their pilot teams have been able to employ specific procedures and tools in project decisions;

3. the amount of management understanding of, and support for, the implementation of the IPPD process in their projects;

4. the manner in which their projects, to date, had benefited from the IPPD training; and

5. the types of obstacles they encountered that impeded IPPD implementation.

In many cases both overall response data across pilot projects and an indication of the consistency of these responses among individual pilots are provided. Comparisons of projects is difficult because of variation in many factors, such as maturation level of the project, degree of funding, customer demand/support, contractor commitment to use of IPPD process, or degree of conceptual orientation of the project. Therefore, in most sections, individual projects are not identified. However, a 2-3 page summary of the IPPD application experience of each pilot project evaluated is included in Appendix F.

Extent of Present Knowledge and Understanding. Although a person leaving a training program may have a certain impression of the extent of their understanding of the subject matter, that impression may change several months later when they have had to apply that understanding in a work environment. In the case of the IPPD pilots, the perceptions may become more positive due to attendance at additional supplemental courses, mentoring experiences with training consultants, and meetings and discussions associated with the planning or actual implementation effort. In some cases that perception may become less optimistic due to a lack of use of the information over an extended period of time or unsuccessful attempts to apply the process that make the IPT members less confident about their knowledge and ability. The following paragraphs summarize the perceptions that former participants in either the DSSM or AT/IPPD courses had about their understanding of the IPPD process several months after the training experience and at the time they were to be involved in implementation.

Across all the follow-up respondents, there did not seem to be a great deal of difference from the end-of-course responses regarding perceptions of knowledge of the IPPD concepts and methods or understanding of the IPPD initiative, its potential benefits, or its application. As shown in Table 9, the greatest difference is reflected in a less optimistic perception of IPPD knowledge, with 28% claiming a large or very large amount of knowledge at least six months after training (down from 41%) and 17% claiming only a small amount of knowledge (up from 8%). Perceptions of understanding of the reason for the IPPD initiative and of the potential benefits were very similar to earlier perceptions, with more than 60% reporting a good or excellent understanding in both areas. Perceptions about understanding of the application of IPPD again had a noteworthy split, with 32% claiming a good or excellent understanding and 26% reporting no understanding or a slight understanding.

Table 9. Percentage of Respondents Reporting Ability to Apply IPPD Just After and Months After Training

	NONE TO SLIGHT	MODERATE	LARGE TO VERY LARGE
KNOWLEDGE OF IPPD CONCEPTS			
JUST AFTER TRAINING	8%	51%	41%
MONTHS AFTER TRAINING	17%	55%	28%
UNDERSTANDING OF IPPD INITIATIVE			
JUST AFTER TRAINING	4%	32%	64%
MONTHS AFTER TRAINING	8%	23%	69%
UNDERSTANDING OF IPPD BENEFITS			
JUST AFTER TRAINING	5%	34%	60%
MONTHS AFTER TRAINING	9%	28%	63%
UNDERSTANDING OF IPPD APPLICATION			
JUST AFTER TRAINING	19%	41%	40%
MONTHS AFTER TRAINING	26%	42%	32%

Perceived Ability to Apply IPPD to an Appropriate Program. Follow-up perceptions about individual ability to apply the IPPD process are similar to end-of-course perceptions (Table 10), with 28% reporting they are capable or very capable (compared to 32% previously) and 34% reporting they are slightly or not at all capable (compared to 25% previously). The perceived need for additional training before they would feel capable of applying IPPD seems to have decreased slightly. Only 16% indicated they would need a large or very large amount of additional training (compared to 28% previously), and 33% indicated they would need no additional training or only a slight amount (compared to 17% previously).

Table 10. Percentage of Respondents Reporting Ability to Apply IPPD Just After and Months After Training

	EXTENT CAPABLE OF APPLYING IPPD		
	NOT OR SLIGHTLY CAPABLE	MODERATELY CAPABLE	CAPABLE OR VERY CAPABLE
JUST AFTER TRAINING	25%	47%	28%
MONTHS AFTER TRAINING	34%	38%	28%
	IPPD ADDITIONAL TRAINING OR MENTORING NEEDED		
	NONE OR SLIGHT AMOUNT	MODERATE AMOUNT	LARGE OR VERY LARGE AMOUNT
JUST AFTER TRAINING	17%	54%	28%
MONTHS AFTER TRAINING	33%	49%	18%

Extent of Application of IPPD in Pilot Projects. For this evaluation, several factors were analyzed to indicate the extent the IPPD process is being applied as described in the AT/IPPD course. These factors were outlined in the AT/IPPD Training Manual published by the James Gregory training consultants (Brinkman & Peisert, 1997), and include:

1. degree of customer/user involvement in requirements determination and throughout the IPT activities;

2. clear determination of performance and technology requirements and development of exit criteria;

3. development of a House of Quality to document the establishment of performance and engineering requirements;

4. analysis of technology/design alternatives based on the use of tests, experiments, and/or existent data and documented using Technology Worksheets;

5. decisions based on comparisons of data relating to alternatives' performance, producibility, cost, etc., and documented using Value Scorecards;

6. development of a Technology Transition Business Plan (TTBP) to summarize cost, risks, benefits, and transition assessments.

General estimations of the extent to which the IPT pilots have employed these IPPD procedures and that training participants have actually been involved in this application are difficult to achieve only with data from the follow-up questionnaire. Differences in the numbers of respondents representing various pilot projects may make some overall assessments across the entire respondent group misleading. A more relevant assessment can be made using questionnaire results from each pilot and a qualitative summary based on interviews with key IPT personnel.

Individual Application of IPPD Procedures: The questionnaire data provide some indication of the extent to which individual training participants actually have been able to apply IPPD procedures. For example, the data reveal that a number of the training participants claim to have had much greater involvement in the IPPD application than others. In fact, 48% of the respondents indicated they have participated "to a slight extent" or "not at all" in the overall application of the IPPD process in their project. On the other hand, 25% reported participating to "a large" or "very large" extent. In addition to this general variation in level of participation across all respondents, there is also a noticeable degree of variation among the different pilots in terms of their members' participation in IPPD application. For example, Table 11 shows five pilots in which more than 60% of the respondents report slight or no participation in IPPD application and three pilots in which 100% of the respondents report at least moderate or greater participation.

Table 11. Percentage of Respondents, by Individual Pilot, Participating at Various Levels in the Application of IPPD to Their Project

PILOT	DID NOT OR SLIGHT EXTENT	MODERATE EXTENT	LARGE OR VERY LARGE EXTENT
1	83	17	0
2	47	29	24
3	0	33	67
4	25	50	25
5	73	0	27
6	0	33	67
7	0	60	40
8	33	22	44
9	83	17	0
10	60	20	20
11	100	0	0

Tables 12-14 outlines the extent to which the respondents reported participating in some of the individual IPPD procedures. For example, the greatest individual involvement seems to have been with the House of Quality (Table 12). In 7 of the 11 pilots, at least 17% of the respondents report significant or prominent participation in the House of Quality, and in 3 of those 7, at least 60% of the respondents report significant or prominent participation.

Possibly because some of the pilots were not yet at the stage of analyzing their design alternatives at the time they filled out the questionnaire, fewer respondents report participation in the use of Technology Worksheets or Value Scorecards. As shown in Table 13, in only four of the pilots did any participants report significant participation with Technology Worksheets.

Table 12. Percentage of Respondents, by Individual Pilot, Participating at Various Levels in Completing a House of Quality

PILOT	DID NOT OR SLIGHT AMOUNT	MODERATE AMOUNT	SIGNIFICANT OR MOST PROMINENT CONTRIBUTOR
1	83	0	17
2	64	18	18
3	33	0	67
4	81	6	13
5	73	0	27
6	33	0	67
7	20	20	60
8	71	0	29
9	100	0	0
10	100	0	0
11	100	0	0

Table 13. Percentage of Respondents, by Individual Pilot, Participating at Various Levels in Use of Technology Worksheets

PILOT	DID NOT OR SLIGHT AMOUNT	MODERATE AMOUNT	SIGNIFICANT OR MOST PROMINENT CONTRIBUTOR
1	100	0	0
2	94	6	0
3	100	0	0
4	73	13	14
5	91	9	0
6	33	67	0
7	75	0	25
8	67	11	22
9	100	0	0
10	60	20	20
11	100	0	0

Table 14 shows respondents reported even less participation in development of Value Scorecards. In only three pilots did respondents report significant or prominent participation, and those respondents totaled 9 of the 80 respondents. The pattern that seems to emerge from these data is that a fairly significant number of those who participated in the DSSM or AT/IPPD training courses see themselves as uninvolved in actual implementation of the IPPD process in their pilots. It may be that, in many pilots, the various IPPD procedures/tools are not used, have not yet been used, or are used by only a minority of the team members.

Application of the IPPD Process Among the Pilot Projects: Of the 13 original IPPD pilot teams, 11 remained as active projects. The difficulty in using questionnaire results to determine the extent to which these pilot projects are implementing the IPPD process is illustrated by the previous section, showing the variation in extent to which individuals are involved with the process. It is possible that some members are unaware of the actual use of IPPD procedures by other team members, because some team members report relatively low levels of participation and others report higher levels. To better assess the teams' application of IPPD procedures, we held small group interviews with key IPT personnel, and pilot program managers completed a final follow-up Process Summary Survey. Results of this data-gathering indicate there is considerable variation among pilots in their use of the various

IPPD procedures presented in the training course. Some pilots have been able to employ many of the six aspects of the IPPD process outlined above, while others have employed very few.

Table 14. Percentage of Respondents, by Individual Pilot, Participating at Various Levels in Use of Value Scorecards

PILOT	DID NOT OR SLIGHT AMOUNT	MODERATE AMOUNT	SIGNIFICANT OR MOST PROMINENT CONTRIBUTOR
1	100	0	0
2	100	0	0
3	100	0	0
4	69	19	12
5	91	9	0
6	33	33	33
7	100	0	0
8	87	13	0
9	100	0	0
10	80	0	20
11	100	0	0

- *Customer Interaction in the IPT Activities.* As outlined in the AT/IPPD training program, one of the most basic aspects in ensuring that affordability is being considered in S&T projects is early and continuous involvement of potential users or customers in the setting of requirements, design analysis, and technology transition planning. Interviews with pilot team members indicate that there was some variance in the extent of direct customer involvement throughout the pilot projects. However, most report significant involvement in the early determination of requirements, especially through the use of meetings specifically dealing with the technology projects. In the Summary of IPPD Processes Survey, program managers were asked to select, from five descriptions of customer interaction, the description that most closely matches the involvement in their pilot project. Table 15 lists these options and the number of pilots that selected each one.

Table 15. Number of Pilots Reporting Various Types of Customer Interaction, from Choices on Summary of Processes Survey

Types of Customer Interaction	No. of Pilots Responding
1. Requirements determined from previous interaction in research area; little additional customer involvement	1
2. Requirements outlined/discussed at general meetings and through documents outlining general needs (e.g., TPIPTs or deficiency documents such as ORDS); little continuous involvement in actual HOQ development or other requirements documentation sessions	2
3. Involved in determining requirements through general means described above and at initial specific meetings regarding the technology project; little continuous involvement in development of HOQ, Exit Criteria, or other requirements documentation sessions	3
4. Continuous involvement at initial sessions and in development of HOQ or other requirements documents a) little continuous involvement after this b) continuous involvement planned, but project not there yet	2
5. Continuous involvement in most aspects of IPT, even after requirements and or exit criteria were established	3

- Determination of Requirements. A second key aspect of the IPPD process is clear determination and documentation of requirements, including performance and engineering requirements, and delineation of exit criteria. In a few pilots, members indicated they had determined general requirements from their years of previous experience with that line of research or from general meetings such as TPIPTs and from requirements or deficiency documents; but they had developed little formal documentation outlining those requirements. However, a majority of pilots reported that they had developed and documented formal performance and engineering requirements, and just under half of the pilots had also completed and fully documented their specific exit criteria. The Summary of Processes Survey offered four potential descriptions regarding the manner in which requirements and exit criteria were developed and documented. Table 16 shows those choices and the number of pilots that selected each option.

Table 16. Number of Pilots Reporting Various Means of Determining Requirements and Exit Criteria, from Choices on Summary of Processes Survey

Means of Determining Requirements	No. of Pilots Responding
1. General requirements outlined from needs documents or meetings, but no formal documentation	3
2. Formal performance requirements developed and documented, but no exit criteria documented	1
3. Formal performance requirements developed and documented, and technology/engineering requirements also outlined and compared, but no exit criteria formally documented	2
4. Formal performance requirements developed and documented, technology/ engineering requirements outlined, and exit criteria formally documented	5

- *Use of a House of Quality.* A key element in the AT/IPPD training program was learning how to use a House of Quality in the delineation of performance and engineering requirements. Many hours were spent in demonstrating how careful use of this tool could help in specification and prioritization of requirements and in early identification of technology gaps that could be costly obstacles in the design and testing of technology options. While four of the pilots indicated that they did not use an HOQ, one of those four said that the had used a process for laying out requirements that had a similar result. Seven of the pilots reported that they were either working on or had completed an HOQ, and most of those suggested that the process, while not easy, had several benefits. The use of this tool had forced them to confront requirements issues in a structured way, it had brought constituent members together to share and understand their differing perspectives, and it made it more difficult to select "favored" technology options without having to meet common specified criteria. The four response options from the Summary of Processes Survey, describing the use of the HOQ, are listed in Table 17, along with the number of pilots that indicated their own experience most closely matched one of those options.

Table 17. Number of Pilots Reporting Extent of Use of House of Quality, from Choices on Summary of Processes Survey

Extent of Use of HOQ	No. of Pilots Responding
1. No House of Quality developed in determining requirements	3
2. Process for determining requirements used that had similar result as HOQ (please describe or give example)	1
3. HOQ begun and still working on it	5
4. HOQ completed	2

- *Comparison and Documentation of Design Alternatives and Completion of Value Analysis.* In the IPPD process a systematic approach is used in comparing and making decisions about design or technology alternatives. As demonstrated in the training program, data are gathered through testing, experiments, or other means to screen the initial design options against customer requirements. For each alternative technology considered, performance, producibility and cost data are recorded on Technology Worksheets to identify the extent of variability and risk associated with each option. All of these factors are compared in a value analysis to insure that process as well as product factors are considered in the decision process. There should also be clear documentation of these factors and of the analysis process, using some method such as a Value Scorecard.

Of the various procedures associated with the IPPD process, these two seem to cause more difficulty for the pilots. A number of those interviewed contend that identification of means for testing the designs, actual cost of testing a number of alternatives, and difficulty in obtaining or projecting maintainability, failure rates, or other data related to life cycle costs has kept them from using these IPPD procedures. They also contend that many differences among design options are intuitively obvious, and meticulous documentation of some of these considerations is wasteful. Others express the need for tools to help them gather the data for comparisons. Whatever the reason, collection of data for testing design alternatives is consistently cited as the most difficult aspect of IPPD implementation. In spite of this difficulty, a majority of pilots report that they collect some data for comparing design alternatives, and about half indicated they had formally documented the results; but only three reported using Technology Worksheets or Value Scorecards to document their decision process.

In the Summary of Processes Survey, there are five response options pertaining to the procedures for comparing and analyzing design alternatives and five options pertaining to procedures for performing a value analysis. Tables 18 and 19 show those options and the number of program managers who selected each one as being most closely related to their pilot's experience.

Table 18. Number of Pilots Reporting Various Means for Comparing and Documenting Design/Technology Alternatives, from Choices on Summary of Processes Survey

Means of Comparing Design/Technology Alternatives	No. of Pilots Responding
1. Decisions regarding technology/design alternatives based on assessments of experienced researchers, or current knowledge; little testing or data gathering required	2
2. Decisions regarding technology/design alternatives based on tests, experiments and data gathered; little formal documentation of results	4
3. Decisions regarding technology/design alternatives based on tests, experiments, and data gathered; formal documentation using methods other than IPPD Technology Worksheets (please describe method)	2
4. Decisions regarding technology/design alternatives based on tests, experiments, and data gathered; formal documentation using IPPD Technology Worksheets	0
5. Project not at this point yet, but intentions are most likely to reflect description 1 2 3 4 above (please circle)	3 (will be option 4)

Table 19. Number of Pilots Reporting Various Means for Carrying Out/Documenting a Value Analysis, from Choices on Summary of Processes Survey

Means for Carrying Out/Documenting Value Analysis	No. of Pilots Responding
1. Decisions based on general intuitive considerations of information relating to alternatives' pros and cons; no formal documentation of analysis process	1 and 1/2
2. Decisions based on general intuitive considerations of information relating to alternatives' pros and cons; documentation of analysis process used methods other than Value scorecards (please describe methods)	4 and 1/2
3. Decisions based on data relating to alternatives' performance, producibility, costs, etc.; documentation of analysis process used methods other than Value Scorecards (please describe methods)	2 (1 and 2 halves)
4. Decisions based on data relating to alternatives' performance, producibility, costs, etc. ; documentation of analysis process included use of Value Scorecards	0
5. Project not at this point yet, but intentions are most likely to reflect description 1 2 3 4 above (please circle)	3 (will be option 4)

- *Development of a Technology Transition Business Plan.* A final aspect of the IPPD process that is outlined in the AT/IPPD course is the development of a Technology Transition Business plan. Although most pilots reported the development of a Technology Transition Plan (TTP) early in the requirements phase of their project, none of them has yet to build a TTBP using the products of the IPPD procedures demonstrated in the course. One program manager indicated his pilot had developed a TTBP-like document that summarized their assessments of cost, risk, benefits, and transition factors without using the HOQ and IPPD design analysis tools, and three others indicated they intend to complete a TTBP as their project matures. There are four response options pertaining to the development of a TTBP in the Summary of Processes Survey; Table 20 shows the number of pilots that associate their TTBP experience with one of those options.

Table 20. Number of Pilots Reporting Extent of Development of a Technology Transition Business Plan (TTBP), from Choices on Summary of Processes Survey

Extent of Development of a TTBP	No. of Pilots Responding
1. TTBP not developed	6
2. TTBP developed summarizing cost, risk, benefits, and transition assessments, arrived at through Value Scorecard, HOQ requirements and other IPPD products	0
3. TTBP developed summarizing cost, risk, benefits, and transition assessments, arrived at by means other than IPPD products	1
4. Project not at this point yet, but intentions are most likely to reflect description 1 2 3 above (please circle)	4 (will be option 2)

Participation in Supplemental Training and Mentoring Opportunities

To aid in educating IPPD pilot team members and assisting them with IPPD implementation in their projects, training consultants provided three supplemental courses to the AT/IPPD or DSSM participants. They presented a Design of Experiments (DOE) course, a Design To Cost (DTC) course, and a short DSSM course. In addition, four members who had taken the original DSSM course in 1996 also attended an AT/IPPD course in 1997. Consultants also were available for individual mentoring visits to, and communications with, the various pilots and offered to participate in the pilots' IPT sessions.

As of November 1997, the DOE course was best attended, with 63 members from pilot IPTs attending. Thirteen IPT members attended the Design to Cost course, and four former AT/IPPD attendees also attended a two-day DSSM course. Of all those taking supplemental training, 12 IPT members took two additional courses and three took three. From comments made during the interview sessions and on the Follow-up Questionnaire, the DOE course was considered very beneficial. Some members indicated it ought to be a required course for all those entering the laboratory R&D environment. Table 21 shows the number and percentage of respondents who report attending supplemental courses. It reveals that two thirds of the respondents took advantage of the additional educational opportunity, having attended at least one additional course, and 22% attended two or more.

Table 21. Respondents' Participation in IPPD Supplemental Courses

NUMBER OF ADDITIONAL COURSES	NUMBER OF RESPONDENTS	PERCENTAGE OF RESPONDENTS
0	28	33%
1	39	45%
2	16	19%
3	3	3%
TOTAL	**86**	**100%**

Mentoring or ongoing technical support to IPTs, both before and after training, included IPPD process implementation planning sessions, IPT review attendance, and assistance with requirements determination, HOQ development, design of experiments, and development of tools or methods to measure performance requirements or other factors considered in analysis of design options. Respondents to the Follow-up Questionnaire indicated engaging in as many as 20 additional mentoring interactions, some of which could have included telephone guidance and assistance. Table 22 shows the number of mentoring communications reported by the Follow-up respondents. It is interesting that 55% of the respondents report no mentoring contact, while 10% report at least six or more mentoring communications.

The researchers attempted to determine if there was any indication of a relationship between involvement with supplemental courses or mentoring activities and perceptions of knowledge, understanding, and ability to apply IPPD procedures. To check this relationship, they compared the responses of those who had attended different numbers of courses, and they also compared the responses of those who reported differing numbers of mentoring contacts. Across all responses dealing with knowledge, understanding, and perceived ability to apply, there appeared to be no meaningful differences between those who had taken no additional courses and those who had taken one or two additional courses. There was a consistently higher perception of knowledge, understanding, and ability to apply IPPD among those who had taken three additional courses, but the small number of respondents in that category prevents any conclusion of a relationship between number of courses and perceived levels of IPPD knowledge, understanding, and ability to apply the process.

Table 22. Number of Mentoring Incidents Reported by Respondents

NUMBER OF MENTORING INCIDENTS	NUMBER OF RESPONDENTS	PERCENTAGE OF RESPONDENTS
0	55	65%
1	6	7%
2	4	5%
3	7	8%
4	4	5%
6	5	6%
8	1	1%
10	1	1%
16	1	1%
20	1	1%
TOTAL	**85**	**100%**

This same type of comparison was made among those who reported differing numbers of mentoring communications. Respondents were grouped by those who had no mentoring contacts (n = 54), those who reported between one and five contacts (n = 21), and those who reported six or more (n = 9). Table 23 shows the comparison of responses regarding knowledge of the IPPD process. It is evident that those with six or more contacts feel most optimistic about their IPPD knowledge, while those with a few mentoring contacts report the least amount of knowledge. Table 24 shows the same pattern of differences among the respondents' perceptions of their ability to apply the IPPD process. In fact, this pattern is consistent across all of the knowledge, understanding, and application ability responses.

Table 23. Amount of IPPD Knowledge Reported by Respondents with Various Amounts of Mentoring Communication

	PERCENT REPORTING AMOUNTS OF IPPD KNOWLEDGE		
NUMBER OF MENTORING INCIDENTS	SLIGHT OR NONE	MODERATE	LARGE TO VERY LARGE
0	19%	54%	28%
1-4	19%	62%	19%
6 +	0%	44%	56%

Table 24. Ability to Apply IPPD, Reported by Respondents with Various Amounts of Mentoring Communication

	PERCENT REPORTING CAPABILITY OF APPLYING IPPD PROCESS		
NUMBER OF MENTORING INCIDENTS	SLIGHT OR NONE	MODERATE	LARGE TO VERY LARGE
0	35%	38%	27%
1-4	38%	43%	19%
6 +	11%	33%	56%

Additional support and a probable explanation for this relationship between a larger amount of mentoring and greater confidence in IPPD knowledge and ability is provided by the reported level of individual involvement with IPPD application in their respective pilots. As seen in Table 25, the heavily mentored group all report having participated to a large or very large degree in their IPPD application, while those receiving less mentoring also report far less participation. It is likely that the heavily mentored respondents are all key players in their projects' IPPD efforts, and they have sought a lot of additional guidance so they could become proficient in that role.

Table 25. Extent of Participation in Application of IPPD to Project, Reported by Respondents with Various Amounts of Mentoring Communication

	PERCENT REPORTING EXTENT OF PARTICIPATION IN IPPD APPLICATION		
NUMBER OF MENTORING INCIDENTS	SLIGHT OR NONE	MODERATE	LARGE TO VERY LARGE
0	58%	29%	13%
1-4	38%	33%	29%
6 +	0	0	100%

The point that may be considered here is one of immersion: that, when introducing a new process or concept, after a certain level of involvement and guidance, confidence in one's ability is finally gained, and a level of comfort with the new process is reached. The more important relationship that may develop once this point is reached is commitment to or belief in the new process. As shown in Table 26, almost all (89%) of those who reported a great deal of mentoring (and also who were all actively involved in their IPPD application) also report a great likelihood that they will employ IPPD in future projects. Although there may be many other explanations for this relationship, this view is also supported by the comments of several of those interviewed who expressed a positive view of the potential for implementing IPPD in their projects. Those most positive all referred to past experiences (sometimes in a manufacturing environment) in which they had successfully employed IPPD (or very similar) procedures. They commented that it might take a lot of effort to convince their less committed colleagues that the IPPD process will be beneficial over "business as usual," but their experience level with the process has kept them committed to that effort.

Table 26. Likelihood of Applying IPPD in Future Projects, Reported by Respondents with Various Amounts of Mentoring Communication

	PERCENT REPORTING LIKELIHOOD OF APPLYING IPPD IN FUTURE		
NUMBER OF MENTORING INCIDENTS	UNLIKELY OR HIGHLY UNLIKELY	50% CHANCE	LIKELY OR HIGHLY LIKELY
0	25%	40%	35%
1-4	24%	38%	38%
6 +	0	11%	89%

Perceptions of Management's Knowledge/Understanding/Attitude/Support

A key factor in the implementation of any new program requiring personnel to change their methods of operating is the perception of management commitment and support. In fact, the importance of this factor was recognized by the DOD S&T Affordability Task Force when they issued their "Criteria for Assessing a Focus on Affordability in S&T Program Management" in 1997. One of the five major areas outlined as essential for evaluating the affordability initiative is management's willingness and ability to support Integrated Product and Process Development. Both through the Follow-up Questionnaire and the interviews, researchers gathered information reflecting the pilot members' perceptions of management's understanding of IPPD and belief in the ability to apply IPPD successfully in the S&T environment. Data pertaining to those perceptions were previously gathered from participants at the AT/IPPD training sessions and are reported above (Figures 9 - 14). The follow-up questions were designed to capture the perceptions of IPPD pilot members as they, and their managers, actually faced the difficulties of implementing new procedures within the constraints of the workplace environment.

After six or seven more months of experience with the prospect of applying IPPD in their workplace, the respondents did not have any more optimistic view than they had going through training, of management's understanding of IPPD or of their belief that IPPD is being successfully applied. In their estimates of management's knowledge of the process and understanding of how to apply it to their project (summarized in Table 27), at least 50 % of the respondents reported either not knowing management's degree of understanding or feeling it is slight or nonexistent.

Table 27. Percentage of Respondents Reporting Management's Levels of IPPD Knowledge and Understanding

KNOWLEDGE OF IPPD CONCEPTS AND METHODS			
DON'T KNOW	NONE OR SMALL AMOUNT	MODERATE AMOUNT	LARGE OR VERY LARGE AMOUNT
7%	49%	29%	15%

UNDERSTANDING OF HOW IPPD METHODS APPLY TO PROJECT			
DON'T KNOW	NONE OR SLIGHT	MODERATE	GOOD OR EXCELLENT
9%	51%	24%	15%

The respondents' perceptions are similar when it comes to management's opinion of how successfully IPPD has so far been applied and the amount of benefit that IPPD has brought to the project. As shown in Table 28, at least 67% either didn't know management's opinion or felt management thought application was weak or nonexistent. The table also shows that nearly 80% either didn't know management's opinion or felt management thought IPPD had brought small or no benefits.

Table 28. Percentage of Respondents Reporting Management's Perceptions about Success of IPPD Application in Pilot Projects and the Extent of Benefits Gained

LEVELS OF SUCCESS OF IPPD APPLICATION			
DON'T KNOW	WEAK OR NONEXISTENT	MEDIOCRE	SUCCESSFUL OR HIGHLY SUCCESSFUL
28%	39%	19%	14%
EXTENT OF BENEFITS FROM IPPD			
DON'T KNOW	NONE OR SMALL	MODERATE	LARGE OR VERY LARGE
30%	49%	16%	5%

Beyond the perceptions of management's understanding of IPPD and of management's opinions of its application and benefit, are the respondents' perceptions of the support for those steps needed for successful implementation. Support for attendance at initial IPPD training is perceived to have been relatively strong. Table 29 shows 67% of respondents reporting "strong" or "very strong" management support for this training. Support for supplemental training or mentoring, however, was reported to be much less enthusiastic. Only 28% of respondents reported receiving strong or very strong support for these additional means of assistance, and 36% indicated their support was slight or nonexistent. Probably most important were perceptions of management support for the actual use of IPPD methods in the project. Again, only 31% of respondents reported strong or very strong support, while 8% did not know what level of support they had, and 33% felt their support was slight or nonexistent. These data, also displayed in Table 29, when combined with the perceptions of management knowledge and attitudes expressed at the AT/IPPD training sessions, do not reflect that a message of strong management support, deemed essential by the S&T Affordability Task Force, is being received by the pilot team members.

Table 29. Percentage of Respondents Reporting Extent of Management Support for IPPD Training and Use of IPPD Methods

MANAGEMENT SUPPORT FOR INITIAL IPPD TRAINING			
DON'T KNOW	NONE OR SLIGHT	MODERATE	STRONG OR VERY STRONG
3%	4%	26%	67%
MANAGEMENT SUPPORT FOR SUPPLEMENTAL TRAINING OR MENTORING USE			
DON'T KNOW	NONE OR SLIGHT	MODERATE	STRONG OR VERY STRONG
11%	36%	26%	28%
MANAGEMENT SUPPORT FOR USE OF IPPD METHODS			
DON'T KNOW	NONE OR SLIGHT	MODERATE	STRONG OR VERY STRONG
8%	33%	28%	31%

Perceptions of Benefits to Projects

One of the most difficult things to ascertain in this evaluation is whether the IPPD training and resultant implementation provided benefits to the pilot projects. To help answer this question, researchers gathered information both from the Follow-up Questionnaire and the group interviews. The Questionnaire respondents were asked to estimate, generally, the extent their program had benefited from use of IPPD methods and, specifically, the extent to which the team's application of IPPD had helped reduce costs, shorten timelines, increase productivity, or identify risks. In addition, they were asked about the usefulness of the IPPD course and how important or beneficial it would be for others to take the course.

Early in the series of interview sessions, the research team realized the determination of benefits is confounded by several factors. These include differences in the extent to which various pilots actually implemented the IPPD process, the lack of knowledge of many respondents about their team's implementation, and the fact that several of the pilots had not progressed far enough along to really allow

for noticeable benefits to be realized. Although the questionnaire data in general revealed little in the way of tangible benefit to the areas described, the team members interviewed did describe some less concrete ways in which the IPPD effort helped their programs. In the following paragraphs we will provide, first, a brief summary of the respondents' perceptions of benefits described in the Questionnaire, and then a short summary of the benefits described by those interviewed.

Perceived Benefits of Application of IPPD Methods. When asked to estimate the extent to which the use of IPPD methods benefited their pilot project, relatively few respondents reported large or even moderate benefits. As shown in Table 30, 27% indicated IPPD benefited the overall pilot project moderately, and only 7% reported IPPD benefited the project "greatly" or "excellently." That pattern holds when asked about specific types of benefits, such as helping reduce costs, increase productivity, shorten timelines, or identify risks. Table 31 shows that a fairly large percentage (as much as 38%) of respondents indicated they don't know whether IPPD use benefited any of these areas, and over 50% consistently indicated benefits to these areas were slight or nonexistent. The most benefit was reported to be in the identification of risks, where 33% indicated IPPD benefited this area at least moderately or greater. An interesting side note to these perceptions is that respondents did see greater potential benefit from implementation of IPPD methods--in other 6.3 programs. As seen in Table 30, 46% indicated IPPD would benefit other programs to a large or very large extent, and 86% said it would benefit other programs to a moderate extent or greater. This may be an indication that the general logic and philosophy of the IPPD process is appreciated, but that the teams were not able to implement them with much noticeable benefit in these first pilots by the time the Questionnaire data were collected.

Table 30. Respondents' Perceptions of Extent IPPD Application Provided or Would Provide Overall Benefits to Their Project or Other Projects

PERCENT REPORTING EXTENT IPPD USE BENEFITED THEIR PROGRAM		
NONE OR SLIGHTLY	MODERATELY	GREATLY OR EXCELLENTLY
66%	27%	7%
PERCENT REPORTING EXTENT IPPD COULD BENEFIT OTHER 6.3 PROGRAMS		
NONE OR SMALL	MODERATE	LARGE OR VERY LARGE
14%	40%	46%

Table 31. Respondents' Perceptions of Extent IPPD Application Benefited Specific Aspects of Their Project

PERCENT REPORTING IPPD HELPED REDUCE COSTS			
DON'T KNOW	NOT AT ALL OR SLIGHT	MODERATE	LARGE OR VERY LARGE
38%	53%	6%	3%
PERCENT REPORTING IPPD HELPED SHORTEN TIMELINES			
DON'T KNOW	NOT AT ALL OR SLIGHT	MODERATE	LARGE OR VERY LARGE
34%	58%	8%	0
PERCENT REPORTING IPPD HELPED INCREASE PRODUCTIVITY			
DON'T KNOW	NOT AT ALL OR SLIGHT	MODERATE	LARGE OR VERY LARGE
22%	58%	16%	4%
PERCENT REPORTING IPPD HELPED IDENTIFY RISKS			
DON'T KNOW	NOT AT ALL OR SLIGHT	MODERATE	LARGE OR VERY LARGE
15%	52%	27%	6%

Respondents' Perceptions of Usefulness of the IPPD Course. Although respondents did not report a great amount of benefit to their programs (yet) from the actual implementation of IPPD methods, most did seem positive about the utility of the IPPD course. Table 32 shows that 46 % indicated that the information provided would be moderately useful for their general professional development, and another 42% reported it would be quite or extremely useful. In addition, the respondents indicated that it was important for other members of their team to take the course. Greater than 75% of the respondents reported that it was important for all government members and all contractor members of the team to take the course, either at the same time or at some point. The response regarding the utility of the IPPD course for colleagues doing similar work, but who are not part of the IPPD pilot project, is most telling. As shown in Table 32, 38% indicated it was appropriate for some of their colleagues, and 24% indicated that it was more than just appropriate or that they would strongly recommend it for those colleagues.

Table 32. Respondents' Perceptions of Training Utility

PERCENT REPORTING IPPD COURSE USEFUL FOR PROFESSIONAL DEVELOPMENT		
NO USE OR VERY LITTLE	MODERATELY USEFUL	QUITE OR EXTREMELY USEFUL
12%	46%	42%

PERCENT REPORTING IMPORTANCE OF ALL GOVERNMENT MEMBERS ATTENDING COURSE		
NOT IMPORTANT	YES, AT SOME POINT	YES, AT SAME TIME
23%	39%	38%

PERCENT REPORTING IMPORTANCE OF ALL CONTRACTORS ATTENDING COURSE		
NOT IMPORTANT	YES, AT SOME POINT	YES, AT SAME TIME
22%	37%	41%

PERCENT RECOMMENDING IPPD COURSE FOR COLLEAGUES OR OTHER PROEJCTS			
NO	WILL PROVIDE A LITTLE BENEFIT	APPROPRIATE FOR SOME	STRONGLY RECOMMENDED
9%	28%	38%	24%

Perceptions of Ancillary Benefits of IPPD Implementation. Despite the relatively small numbers of Questionnaire respondents who reported seeing substantial benefits to specific areas of their pilot projects, those members interviewed repeatedly mentioned ways in which their attempt to implement IPPD procedures had assisted their projects. The most frequently mentioned benefit was seen in their efforts to specify performance and engineering requirements with a House of Quality. Members from at least five of the pilots indicated that this practice had helped (or forced) them to use a structured means for articulating performance and engineering factors that might have been given less emphasis in the past. It gave everyone a common way of defining and prioritizing the requirements and forced them to confront how they would measure those requirements. It also made it more difficult for any group to lobby for a specific process unless they could show how it stacked up against the stated requirements.

The second most frequently cited benefit was the emphasis on increased communication with users and customers in the definition of requirements and exit criteria. Members of some projects said competing customer requirements sometimes made the development of a House of Quality difficult and, in some cases, the customers grew impatient with the structured HOQ process. However, the consensus was that bringing in the potential users aided in requirements definition, gave them a greater stake in the entire R&D process, and made it more possible to obtain needed data (such as for cost or supportability comparisons).

Another benefit cited was the positive impact on team interaction and communication that IPPD implementation brought about. Not only with customers, but also with various contractor groups and even among different government stakeholders, the need to gather structured input for such procedures as the HOQ or to determine how the team was going to implement the IPPD procedures forced greater interaction and sharing of different perspectives. The setting up of Web sites and more frequent teleconferences enhanced communication among different groups, and more structured documentation of requirements and decision parameters provided a better trail of the decision processes and rationale and lessened the opportunity for misunderstandings.

The pilot team members who described these benefits indicated that these are all factors that should be taken into account in any effective R&D team effort. However, the rigor of the IPPD process lessened the tendency to let some of these practices slide. In fact, for some of the pilots, there was somewhat of a "Hawthorne effect." That is, the IPPD process' emphasis on more rigorous procedures for defining requirements and testing options caused even members of some of those pilots that were less able to implement IPPD to reexamine the ways they made decisions and consider how they were addressing affordability.

Obstacles to Implementation of IPPD

As they described their experiences in implementing IPPD methods in their pilot projects, team members identified several factors that made it difficult to apply the process outlined in the training program. In the interview sessions, the IPT members' comments seemed to coalesce around three main areas: lack of sufficient tools or methods to accomplish the robust testing and data-gathering needed in the design analysis and value analysis phases of the IPPD process; lack of time and resources, within their current project funding, to develop the tools and accomplish the additional testing, data gathering, and documentation required; and an inability to adapt the IPPD process to the particular nature of the project because of its very early conceptual stage or its software engineering orientation.

In some of the projects, the IPT members indicated that it would be hard to gather data on some of the design factors they would be considering because (a) there were few or no existing data on these new concepts, (b) they didn't have the means to build and carry out repeated tests cost-effectively, and (c) they had not developed simulations or other surrogate means for gathering those data. Therefore they indicated they collected harder data where it actually existed, carried out tests where they had the tools to do so cost effectively, and relied on intuitive analyses for other comparisons. Some of the program managers also indicated that they had been able to develop some metrics and means for experimental testing with the help of the training consultants. They stressed that additional help with developing tools for R&D data analysis was necessary for IPPD to be more widely applied.

Several programs suggested that development of tools and carrying out tests might have been possible, but the actual costs and time required to do so would not fit into their funding parameters. Those costs had not been part of the original budget and contractors were not willing to absorb the additional costs. Interviewees indicated that requirements for completing rigorous testing would have to be written into contracts and accompanied by additional funding needed to develop the methods and carry out the tests.

The third commonly perceived obstacle was that the very early conceptual nature of the project meant that many of the conditions and variables were changing as new knowledge led to new approaches and requirements. One manager indicated the IPPD procedures were much more appropriate for a later phase of his project, when the earliest concepts had been worked out and requirements and design parameters would be less fluid.

Related to these concerns were the perceptions of IPT members from two software engineering projects who indicated that they had not been able to determine how to apply the IPPD procedures to an iterative design process used in software engineering. The training consultants will be working with members of one of the software projects to see how the IPPD procedures could be used.

In addition to comments at the interviews, information related to perceptions of these obstacles was gathered through responses to the Follow-up Questionnaire. In the earlier Participant Questionnaire, administered at the training sessions, respondents had been asked to estimate the influence that four factors might have in preventing IPPD application (see Table 8). In the Follow-up Questionnaire, respondents were asked to use the same scale to indicate the amount the same four factors, plus an additional three factors identified through discussions with pilot members, had played in hindering the successful application of IPPD in their pilot projects. Results from the latter instrument seem to support some of the perceptions expressed in the interviews.

Table 33 shows respondents' perceptions regarding the impact of these various obstacles. It is evident that the most prominent obstacle was one of those just cited above: that there are still too many unknown or changing variables in the early stage of the project to apply IPPD. In seven of the pilots, at least 50% or more of the respondents indicated this factor hindered the IPPD application a large or very large amount. The problem of the project's special needs was the next frequently cited obstacle, with at least 50% of the respondents in five pilots indicating it hindered to a large or very large degree. The third most cited obstacle was the lack of resources and materials. The fourth most frequently cited obstacle was "other," which actually included a cross section of different write-in factors, including more detailed explanations of the seven listed factors. The most prominent of the different "other" factors were (a) the pilot projects were at too immature a stage to benefit from the IPPD process, (b) not having sufficient members of the IPT trained in IPPD procedures, and (c) geographic separation of team members.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results from all of the information-gathering efforts described above, the researchers offer the following conclusions regarding the initial AT/IPPD and DSSM training programs and the pilots' implementation of IPPD procedures. They also include several recommendations that may make future training and implementation more effective.

Table 33. Percent, by Pilot, Indicating Various Factors Hindered Their IPPD Implementation a Large or Very Large Amount

	PILOT TEAMS										
Hindering Factors	1	2	3	4	5	6	7	8	9	10	11
Too many unknown or changing variables	100	25	67	60	55	33	80	0	83	60	0
Project has special needs/ qualities not to IPPD	33	19	67	53	18	33	40	0	100	80	75
Too far along in project to employ	0	13	100	20	0	0	0	0	83	60	50
Not enough time	17	44	0	40	45	0	0	0	17	60	25
Not enough knowledge or training on IPPD	33	12	67	20	9	0	0	11	0	0	0
Not enough resource materials available	33	31	33	20	54	0	60	11	17	20	100
Not enough support or emphasis from management	33	10	67	13	18	0	0	11	0	0	50
Other	33	25	67	33	26	100	20	11	50	20	25

The Initial AT/IPPD Training Session

The AT/IPPD Course Initially Improved the Knowledge, Understanding, and Attitudes of Attendees. Based on feedback at the training sessions and from the Participant Questionnaire, it is evident that the AT/IPPD training participants perceived themselves as having greater knowledge and understanding of the IPPD process than they had prior to training. They also reported more positive perceptions about the likelihood that the process could be applied successfully to their project and that it was likely to provide actual benefits. This course was designed as an introduction to most of the major processes, and was not intended to enable the participants to apply the procedures covered without further training or assistance. That limited objective seemed to be borne out by the comments and responses of the learners, who had absorbed a lot of information but knew they would need much more knowledge and skill than they had acquired in the class in order to implement IPPD in their projects.

Changes Should Be Made to Make the AT/IPPD Course Even More Effective. Despite the reported cognitive and affective gains, the initial AT/IPPD course was in need of some improvement to make it more acceptable and relevant for the S&T audience. Remarks during the course and write-in comments on the Questionnaire revealed several areas of concern. Most common was the desire to have the course, especially the URV exercise, more related to R&D situations, and preferably to situations encountered by the pilot projects. There was a strong feeling that too much material was attempted in the time period, and that segments were too math-intensive for a portion of the learners. It was obvious from observing the exercises that there was a fairly large difference in statistical capability among the training participants and that some trainees were lost and frustrated at times. It was also obvious from one of the first sessions that holding the training at the work site led to participants' attempting to deal with work issues in between (and even during) class modules. Off-site training was accomplished for most of the

other sessions. This and other feedback were provided to the training consultants, and they attempted to make some adjustments in pace and in the exercise by their later sessions. The consultants seemed sensitive to continuously improving the effectiveness of the IPPD education process, and they have indicated they are developing a new version of the AT/IPPD course to address the concerns identified in the first round of pilots.

Supplemental Courses and Mentoring Assistance Were Necessary for Application to Projects. As discussed above, the trainees generally came away from the AT/IPPD course feeling somewhat positive about the IPPD process and willing to try to apply it, but knowing that they would need additional help or training before they could implement the process in their projects. This had been anticipated by the consultants, and supplemental training, in the form of the Design of Experiments, Design to Cost, and DSSM courses, were available and recommended by the training team. The DOE course was heavily attended and was well received by those who took it. Numerous comments during interviews indicated that the DOE trainees found it applicable to their work and thought it should be a standard course for S&T laboratory researchers. Fewer people took the other two courses, and there was less feedback about their applicability. For some who took the DSSM course the orientation was still too manufacturing-related. Comparisons of data from the Follow-up Questionnaire regarding perceived IPPD knowledge and understanding among those who took different numbers of supplemental courses showed little difference between those who took no additional courses and those who took one or two courses.

More important than the supplemental courses were the additional mentoring opportunities provided by the training consultants to individual pilots. Most groups who made any progress with the application of IPPD indicated they relied on the assistance of the consultants to help them outline requirements, build an HOQ, or even determine metrics or tools for gathering data for decision analyses. Comparisons regarding levels of knowledge and understanding among those who had different amounts of mentoring contact supported the efficacy of that assistance. Those who had received six or more mentoring contacts indicated they were much more involved with the application of IPPD in their projects and that they had a relatively greater level of knowledge and understanding of the IPPD process. More important, they also indicated that they were very likely to use the IPPD procedures in other projects. This was most likely a group of key players in their project's IPPD implementation, who were working closely with the consultants, trying to make the process work. This information indicates the education process for effective implementation of IPPD is ongoing and requires assistance of knowledgeable consultants through the first implementation experiences. It also is likely that, when that assistance is received and the implementers reach a level of comfort with the process, their belief in its value and motivation to continue its use increases. Thus, for the long-term implementation of IPPD, the goal should be to get as many of the researchers as possible to that comfort level.

Potential Exists for Employing Alternative Means of Training Delivery. As they observed the AT/IPPD sessions and discussed the types of post-training interaction that took place between project teams and the consultants, the researchers were also considering the potential for alternative means of training delivery. Their conclusion is that the introductory AT/IPPD course ought to be taught in the traditional classroom mode, but that there are ample opportunities for exportable training in the follow-up activities and assistance that will help the implementers as they apply the process. The AT/IPPD course is an introductory learning experience for those who are about to engage in the IPPD application process. From the audiences observed in the original training sessions, many come to this experience with a great deal of skepticism about this new process that, they believe, demands a change in the way they traditionally have been operating. Introduction of a new process frequently requires an attitudinal change as well as development of additional knowledge and skills. In this environment it is essential for

the facilitator to continually read the learners' attitude and motivation, sense and deal with frustration, and apply personal attention when necessary. In addition, the interaction with and facilitation of the teams during the exercises enables group members to learn from one another in those areas with which they feel comfortable. With these requirements, exportable interactive courseware or internet-based training could not match the instructors' ability to derive immediate, often nonverbal, signals and respond with an alternate example or explanation that will ease the fears of the learners and enhance their motivation.

However, there seems to be a lot of opportunity for alternative delivery of training after the introductory course, for remedial or tutorial purposes. Modules containing tutorial explanation and exercises can be accessed from a web site and reviewed by pilot team leaders or members just prior to the attempted application of a particular procedure (e.g., development of an HOQ session). Internet or even teleconference communication can be used during IPT sessions to monitor progress and provide advice when the group reaches a difficult point. As the team members get more confident in implementing the procedures and become more positive about the process, motivation may become less of a factor in the learning process and less direct hands-on interaction will be necessary.

Implementation of IPPD in the Pilot Programs

The IPPD Process Seems to Be Working in Several Projects, but Implementation Has Been Inconsistent across Procedures and Pilots. At this point, the IPPD process is clearly not a simple formula that can easily be applied uniformly to all 6.3 S&T projects. The implementation of IPPD in the S&T environment, like the IPPD training, is a work in progress. The consultants as well as the various programs are learning how to apply the process to the variety of situations encountered in the R&D world. Some aspects seem to be more easily applied than others. For example, the emphasis on early customer involvement and on determination of performance and engineering requirements and development of specific exit criteria have been accomplished by most of the pilot teams. In most instances, the IPT members have indicated that attempts to use these procedures have had a positive, but not readily quantifiable, effect on their project. Some pilot team members have questioned whether the amount of extra effort required to involve the customers more fully, lay out the requirements more specifically, and formally document them with a House of Quality are worth it in the long run, especially when their funding and timelines are tight. Ironically, for a group of researchers, they need to be reminded that the first time through a new process usually requires much more time and effort than will be needed when the implementers have more experience with its application.

Other IPPD aspects, especially those related to data gathering, testing, and documentation for the comparison of design/technology alternatives and for the value analysis, have been less rigorously or consistently applied in the early pilots. It is in these areas that additional progress must be made in the education of the S&T community. Tools or methods for data gathering must be developed, and in-depth training or facilitation must be provided to enable project members to accomplish the requisite comparisons and analyses needed for making affordability decisions. At this point, the data-gathering issue, whether it is lack of knowledge, methods, or motivation to put forth the additional effort, seems to be a major sticking point in the consistent application of the IPPD process.

What does seem evident at this time is that some of the pilot projects are making more progress in IPPD implementation and seem more comfortable with the procedures than other pilots. There appear to be four pilots whose efforts more closely reflect those recommended in the AT/IPPD course. The NGT project has aggressively embraced the IPPD procedures from the onset, and the CAI Pervasive project, ALEP, and IRCM all have been actively working at implementation. Of the remaining seven pilots,

three seem to have been able to employ some of the recommended procedures but are struggling with others; three (3-DOC, OTH, and WINDS) showed basically very little application of the IPPD process; and one (ISCP) did little initially but seems much more involved with implementation in a second phase.

It is indicative of the evolving nature of this IPPD learning process, that, as this report is being put in final form, the OTH pilot representatives have met with the training consultants to develop metrics for evaluating relocatable over-the-horizon radar technologies to be introduced into their enhanced demonstration system. If they indeed do develop and apply these affordability metrics, they will be employing some of the IPPD procedures that they, heretofore, had felt were not applicable. This example illustrates both the need for follow-on interaction with the consultants and the difficulty of evaluating IPPD implementation without continuous updating of program status.

Original Selection of Pilots Could Have Been Better. One of the factors that has affected the inconsistent application of IPPD across the first group of pilots is the fact that some of the projects selected were not optimally suited to be part of this test group. Two of the pilots selected were quite far along in their work by the time they had taken the IPPD or DSSM training. One of those actually went back and recreated some of the earlier decision processes using the procedures recommended by the IPPD process. The other of those two projects simply felt too far along and did not implement the IPPD procedures. For other pilots, the implementation was constrained because the requirements for IPPD procedures were not written into the contracts and the contractors balked at having to use more rigorous or different methods than they had originally intended. For another, the program manager was not aware at the start of the project of the additional funding required to do the rigorous testing. And no additional funding was made available, so fewer of the IPPD procedures were accomplished. Another project actually lost some of its funding during the time it was involved as a pilot.

Several Factors Have Been Cited as Necessary for Supporting the Training Efforts and Increasing the Likelihood of Successful Implementation. All the discussions with members of pilot teams, consultants, and IPPD implementation managers have provided insight about some factors that seem related to more successful implementation efforts. The following are the most prominent considerations mentioned consistently:

Upper Management Commitment to Establishment of the IPPD Process Must be Strong and Visible. Both Air Force and industry experience have shown that, when a large change in philosophy or operating procedures is introduced, one of the reactions is for the workforce to wait and see whether the initiative is going to survive before they make a strong effort to embrace it. Experience with several Air Force programs (e.g., Zero Defects, Management By Objectives, and more recently, the Total Quality Initiative - TQI) has made many Air Force personnel suspicious about the lasting effect of such initiatives. One of the signs that the initiative is a serious effort that is not going to just go away is the extent to which management shows enthusiastic support for and confidence in the change effort. This requires them to be knowledgeable about the new program and willing to spend the time and resources to effect the change. The data from both questionnaires as well as the comments of trainees and interview groups, indicate many of the pilot members are not getting a strong signal that management is truly supportive of or even knowledgeable about this IPPD process.

Contractor Commitment to IPPD Must Be Obtained and Maintained. Several program managers expressed their difficulty in getting contractors to cooperate with the IPPD procedures because it required them to adopt new methods or do additional work. Contractors also stated that their original bids were based on standard operating procedures, and that requirements for newer procedures, that take

additional effort, must be written into the contract. Those pilots that were able to do this or who had contractors who were more familiar with IPPD procedures indicated their implementation task was much easier.

Follow-up Education and Involvement With Mentoring is Necessary. Most of the pilots that seem more successful with implementation of IPPD have cited strong involvement with training consultants after the initial training session. The data also show those most inclined to use IPPD in other projects are those who have worked most closely with mentors and have reached a fairly strong level of knowledge and understanding.

Funding the Additional Effort Associated with IPPD is Necessary. Both those who have had difficulty implementing IPPD and those who have been more successful indicate that obtaining funding needed for that effort is essential. As mentioned above, having to take the additional money for additional IPPD training or mentoring or implementation of IPPD procedures has been a stopper for some programs. Two of the programs experiencing more success have been able to shift money within their budgets to cover the additional costs. It is much less likely to have a program implement IPPD when its funding is being constantly under fire or reduced.

Program Manager/Leadership Should Be Knowledgeable About and Committed to the Process. What seems quite clear is that the projects showing most progress with IPPD implementation have program managers or key team leaders that are somewhat familiar with the process or a similar way of doing business. They, because of their experience or belief in the process, seem more willing to work with the consultants and struggle through the learning process, developing the tools and methods needed to apply the process. They admit to being willing to encourage their contractors' or other team members' participation and less willing to accept the members' position that "this is too hard, the process doesn't work."

It Is Difficult to Determine Whether There Are Differences in Applicability by Type of Project or Laboratory. Because there were so many additional variables impacting the implementation of the IPPD process among the different pilots, the question of whether the process is equally applicable across all types of 6.3 S&T projects or at different laboratories remains difficult to answer. The timing of the training and the introduction of the process, the funds and time available for working with consultants to develop tools, the willingness of contractors to implement IPPD procedures, and the general motivation of IPT members varied across the pilots. Plus, the small number of pilots with similar conditions makes generalization very risky. It does seem clear that the application of the process in software engineering projects has yet to be worked out. This does not mean that some aspects of the process would not be helpful to these projects or that better means of applying the process could not be developed. It simply reflects the fact that, in this round, the two pilots that were primarily software engineering projects were unable to determine how to employ the process. The fact that one of the projects was very far along when it began its IPPD affiliation further confounded that effort.

The situation is the same across laboratories. There were two projects each at each of three laboratories and six at another. One lab had two projects, which did not employ IPPD. But one of those projects was the software project that started IPPD very late in the life of the project. A second lab is involved with two projects, and one of those is a software project. The third lab involved with two projects had one canceled as an IPPD pilot due to contractor difficulties. In essence, the small numbers of projects remaining that are not confounded by "special circumstances" makes it impossible to generalize about the applicability of IPPD among various labs.

The IPPD Training Evaluation Effort

The Present Evaluation Effort Had Some Limitations, But Gathered Relevant Data. As described in the Methodology section of this report, the researchers employed several means for evaluating the AT/IPPD training program and the trainees' ability to implement IPPD procedures outlined in that program in their pilot projects. In the determination of the AT/IPPD course and the immediate effect on the skills, knowledge and attitudes of the training participants, the following methods were employed:

1. observation of and participation in each of the AT/IPPD training sessions to experience what the trainees were going through, the relative ease or difficulty of attaining the desired objectives, and the methods and pace of the presentation;

2. discussions with trainees and trainers during the course to get a sense of their level of motivation toward the subject matter, and their own perceptions regarding high and low points of the training program; and

3. a Participant Questionnaire to capture perceptions about pre- and post-training levels of knowledge, understanding, ability to apply the process, and attitudes regarding the likelihood of IPPD being successfully applied and benefiting the projects.

To assess the extent to which the trainees were able to implement the procedures taught in the course and the confounding factors beside skills and knowledge that affect that IPPD application, the researchers used a similar variety of methods:

1. small group and telephone interviews with a sampling of government and contractor members of the various pilot teams;

2. a Follow-up Questionnaire administered to training participants who were still associated with the pilot teams; and

3. a final Summary of Processes Survey, asking program managers to select, from statements describing different levels of involvement with each of six aspects of the IPPD process, the descriptions that most closely match their own pilot's status.

Although additional methods were considered, some limitations in timing and access to the pilot team members prevented their use in this initial evaluation. For example, the researchers were not totally pleased with relying on self-report perceptions of levels of IPPD skill and knowledge. Ideally, they would have liked to develop and administer an objective test to measure mastery of the cognitive learning objectives. In addition, because each project was different and had so many different confounding circumstances, it was difficult to tell whether different implementation outcomes were related to the training or to other conditions associated with the project. And, as with most questionnaires, even after initial pretesting, the researchers would still have altered some of the questions and scales. In general, however, the data and information gathered were able to provide a fairly balanced picture of the immediate effects of the training course and of the level of implementation of the IPPD procedures in the various projects.

Recommendations for a Long-term, Follow-on Evaluation . Based on the initial experience with methods and instruments in this environment, the researchers offer several recommendations for a long-term evaluation effort.

1. Multiple methods of assessment across multiple information sources are necessary. While structured, scaled responses to questionnaire items are useful for quantifying information across larger numbers of subjects, comments captured from open-ended questionnaire items, and especially from discussions and interviews, give better indications of attitude, motivation, frustrations, and other reactions that might be hidden in the responses to simple scaled items. In addition it is necessary to interview and gather questionnaire information from a cross-section of the pilot team members. Contractors, customers, and other government members as well as the program managers will give a more balanced picture and help determine if the program manager is candid or providing a politically acceptable picture.

2. Because so many of the criteria for assessing the implementation of the IPPD procedures (e.g., the extent of customer/user involvement) are not easily quantified, evaluators will have to continue to rely on subjective assessments. These assessments should be refined as the training consultants and the IPTs gain more experience with the implementation of IPPD in the S&T environment and develop more realistic expectations about the outcomes that can result from application of those procedures. Presently those expectations are still being discovered.

3. Evaluation teams should be present at the beginning of each project's IPPD planning and implementation, prior to training.

4. Evaluators should attend the training sessions to determine the participants' degree of commitment to the training, identify any problems with a specific training experience, and see the consultants are attempting improvements.

5. Members of the evaluation team should be familiar with the laboratory S&T environment and the acquisition process. This helps to determine the extent to which difficulties in implementation are due to lack of skill or knowledge, lack of tools or metrics to gather data, lack of commitment to implementation on the part of some team members, or other confounding conditions, such as timing or funding.

6. Ideally, a member of the evaluation team should have experience with successful implementation of the IPPD process. A leader from one of the current successful pilots would be a credible addition.

7. Ideally, evaluators would have access to nonproprietary documents from IPT review sessions and project status reports.

8. Assessment should be periodic and continuous to determine the changes in implementation status and to identify the effects of additional training or mentoring efforts.

General Recommendations

The researchers realize that implementation of IPPD in the S&T environment is a work in progress. From the beginning of the training, the IPPD managers, training consultants, and the evaluation team were aware that the initial AT/IPPD course was a necessary introduction to the process, but was far from sufficient to instill the skills and motivation needed to change the work behavior of experienced

professionals. This formative evaluation project is one method of reviewing this "first effort" and identifying ways to improve both the training and the structure for supporting it. In that spirit, the following recommendations are provided:

1. Select a new series of pilots based on criteria that will foster success. The next group should avoid the obstacles of program timing, funding, and contractor reluctance that hindered implementation in the first series of pilots.

2. In the projects selected, discretionary funding ought to be planned for additional training, mentoring, metrics development, and testing that are likely to be encountered with IPPD implementation. Program managers will need to know how estimate these costs.

3. Use of IPPD methodology should be included in the Statement of Work and other contracting documents to be sure contractors are aware of those requirements. Experience with the IPPD process ought to be one of the criteria for consideration of contract awarding. Program managers will have to know how to word these documents and estimate IPPD experience

4. The program managers and key leadership ought to be knowledgeable about the IPPD process and/or committed to making it work. And, as indicated in the conclusions above, the program leadership has to be strong enough to enforce that commitment throughout their IPTs.

5. Additional IPPD training should be developed for senior management and program managers. For senior managers the general philosophy and processes should be outlined without requiring the extensive mathematical detail of the AT/IPPD course. More important is the discussion of standard obstacles that may impede implementation and methods to prevent or circumvent these and ensure motivation among the IPTs. For program managers the same sort of discussion of obstacles ought to be accompanied by some instruction and/or guidelines for estimating costs of IPPD implementation and for ensuring commitment to IPPD methods among the contractors. These short courses ought to include participation by experienced IPPD implementers from the laboratories who have successfully used the process in their S&T projects and who can share their stories and describe what it took to overcome the nay-sayers.

6. Most important, the IPPD education initiative must be viewed as a long-term incremental process. Changing long-held practices is not accomplished with a one-shot training effort. Mentoring and follow-up with individual pilots is essential to develop the tools and methods needed for the S&T environment and to establish a small group of success stories. The goal ought to be to select carefully the next group of pilots and provide intensive support so that many more members get to that comfort level which leads to belief in the process. Then, from that group, the S&T community will have a small core of experienced facilitators within the various labs. That group will have credibility because their peers know them and yet will have conquered the same fears and potential obstacles that the next group of pilots is facing. The goal of that core of facilitators is to bring about more success stories and more believers who achieve that comfort level. It is this incremental approach, rather than an attempt at a broad-based, surface-level inoculation of training that will have a lasting effect on the way the S&T community approaches affordability.

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APPENDIX A: PARTICIPANT QUESTIONNAIRE

Evaluation Questionnaire

Name _____

Organization _____

Telephone _____

email _____

Instructions: The purpose of this questionnaire is to gather information that will be used to evaluate and refine not just this course, but the IPPD initiative in the science and technology environment in general. As you may know, pilot team members and other interested parties will be asked to supply information via survey, telephone interview, or other means from time to time during the evaluation program. A full evaluation effort will require extensive information about how and how well the IPPD process is implemented across pilot projects. We therefore request your name and other information so that we can follow up on this questionnaire if necessary. <u>However, we will not provide or report identifiable individual responses to anyone.</u> Whenever an item refers to "your 6.3 project," assume that it refers to the pilot 6.3 project to which the IPPD process is being applied and for which you are now being trained.

1. Are you either working on or in some substantial way connected with one of the IPPD 6.3 pilot projects?

Yes ____ No ____ (<u>If</u> your answer is "no" please go to item 1a, after which you are finished with this survey.)

1a. Answer <u>only</u> if you answered "no" to question 1: Since you are <u>not</u> working on or in some substantial way connected with one of the IPPD 6.3 pilot projects, please explain briefly why you were in the course.

2. Which response best describes your employment category?

Government ____ (Military or civil service)

Contractor ____

Other ____ Please explain briefly below (e.g., if you consider yourself a customer or user for a 6.3 program, please say so.)

3. Which of the following best describes your current position (circle one):

(a) Technical Manager/Supervisor
(b) Administrative Manager/Supervisor
(c) Research/Bench Level Engineer/Scientist
(d) Contracting Officer
(e) Other (please describe briefly):

4. How long have you been in your current position? _____ years _____ months

5. How long have you been working in your career field? _____ years _____ months

6. On a scale of 1 - 5, below, indicate how much *prior experience* you have had working as a member of an Integrated Product Team (IPT)?

1	2	3	4	5
no experience	small amount	moderate amount	large amount	very large amount of experience

7. Indicate how much you knew about IPPD concepts and methods *prior to attending this course*.

1	2	3	4	5
no knowledge	small amount	moderate amount	large amount	very large amount of knowledge

8. To what extent did you understand - *prior to attending this course* - the reasons for the IPPD initiative?

1	2	3	4	5
no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

9. To what extent did you understand - *prior to attending this course* - the intended benefits of the IPPD initiative?

1	2	3	4	5
no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

10. To what extent did you understand - *prior to attending this course -* how IPPD methods apply to your 6.3 program?

1	2	3	4	5
no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

11. *Prior to attending this course,* how likely did you think it would be that the IPPD initiative could be successfully applied to your 6.3 program?

0	1	2	3	4	5
had no opinion	application highly unlikely	application unlikely	chances about 50%	application likely	application highly likely

12. *Prior to attending this course,* how likely did you think it would be that IPPD methods could be applied to your 6.3 project with real benefits to the program?

0	1	2	3	4	5
had no opinion	real benefits highly unlikely	real benefits unlikely	chances about 50%	real benefits likely	real benefits highly likely

13. Indicate the extent of your ***present*** knowledge about IPPD concepts and methods.

1	2	3	4	5
no knowledge	small amount	moderate amount	large amount	very large amount of knowledge

14. To what extent do you ***presently*** understand the reasons for the IPPD initiative?

1	2	3	4	5
no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

15. To what extent do you ***presently*** understand the intended benefits of the IPPD initiative ?

1	2	3	4	5
no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

16. To what extent do you ***presently*** understand how IPPD methods apply to your 6.3 program?

1	2	3	4	5
no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

17. Presently, how likely do you think it is that the IPPD initiative can be applied successfully to your 6.3 program?

1	2	3	4	5
application highly unlikely	application unlikely	chances about 50 %	application likely	application highly likely

18. Presently, how likely do you think it is that IPPD methods can be applied to your 6.3 project with real benefits to the program?

1	2	3	4	5
real benefits highly unlikely	real benefits unlikely	chances about 50 %	real benefits likely	real benefits highly likely

In items 19-23,use the 5-point scale to indicate the amount that each of the following factors is likely to play in preventing the successful application of the IPPD process in your project:

1	2	3	4	5
not at all likely	a slight amount	a moderate amount	a large amount	a very large amount

19._____ Too many unknown or changing variables/conditions prevent estimation of reliable parameters

20._____ Our 6.3 project has special qualities or needs that are not amenable to the normal IPPD process.

21._____ We are too far along in our project to employ the process with any worthwhile effect

22._____ Employing the IPPD process will take away time and resources sorely needed to complete the project

23. _____ Add any other factor that would prevent successful application of the IPPD process

24. How much benefit do you think the IPPD process could be to 6.3 programs other than your current program?

1	2	3	4	5
No benefit	small benefit	moderate benefit	large benefit	very large benefit

25. To what extent would you feel capable of applying the IPPD process in an appropriate program?

1	2	3	4	5
Not at all	Slightly capable	Moderately capable	Capable	Very capable

26. How much additional training or mentoring would you need before you would feel capable of applying the IPPD process?

1	2	3	4	5
No additional training	A slight amount	A moderate amount	A large amount	A very large amount

27. How much does your ***management*** (collectively, not just any specific individual) know about IPPD concepts and methods?

0	1	2	3	4	5
I don't know	no knowledge	small amount	moderate amount	large amount	very large amount of knowledge

28. To what extent does your ***management*** (collectively, not just any specific individual) understand the reasons for the IPPD initiative?

0	1	2	3	4	5
I don't know	no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

29. To what extent does your ***management*** understand the intended benefits of the IPPD initiative?

0	1	2	3	4	5
I don't know	no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

30. To what extent does your ***management*** understand how IPPD methods apply to your 6.3 program?

0	1	2	3	4	5
I don't know	no understanding	slight understanding	moderate understanding	good understanding	excellent understanding

31. How likely does your ***management*** think it is that the IPPD initiative can be successfully applied to your 6.3 program?

0	1	2	3	4	5
I don't know	application highly unlikely	application unlikely	chances about 50%	application likely	application highly likely

32. How likely does your ***management*** think it is that IPPD methods can be applied to your 6.3 project with real benefits to the program?

0	1	2	3	4	5
I don't know	real benefits highly unlikely	real benefits unlikely	chances about 50 %	real benefits likely	real benefits highly likely

33. To what extent did your ***management*** support your attendance of this course?

0	1	2	3	4	5
I don't know	no support	slight support	moderate support	strong support	very strong support

34. Apart from any potential benefit to your 6.3 pilot program, to what extent is the information provided in the course likely to be useful for your general professional development/advancement in the future?

1	2	3	4	5
no use	very little use	moderate use	quite useful	extremely useful

35. Are all the government (military or civil service) members of your 6.3 project team taking this course with you? If you answer no, write in the approximate percentage of those who are attending.

Yes ____ No ____ Percent attending _____

36. Are all the contractor members of your 6.3 project team taking this course with you? If you answer no, write in the approximate percentage of those who are attending.

Yes ____ No ____ Percent attending _____

37. Do you think it is important that all the government members on your 6.3 project team take this course at the same time, or at some point?

Yes, at the same time ____ Yes, at some point ____ No, not important ____

38. Do you think it is important that all the contractor members on your 6.3 project team take this course at the same time, or at some point?

Yes, at the same time ____ Yes, at some point _____ No, not important ____

39. Would you recommend that your colleagues (those who do the same general kind of work you do but are not involved in a pilot 6.3 program) take this course?

1	2	3	4	5
would suggest it will provide little benefit		would suggest it is appropriate for some		would strongly recommend they take it

40. Describe briefly any information you received about this course prior to attendance. Also indicate the source of the information (e.g., word of mouth, memos, brochures). If you received no information, just say "none".

41. Were you required to take this course, was it suggested but not required, or did you ask to attend?

Required ____ Suggested, not required _____ Asked to ____

42. **If** you checked *either* "Required" or "Suggested" for item 41, briefly describe the reasons you were given as to why your attendance was required or suggested.

43. **If** you checked "Asked to" for item 41, briefly say why you wanted to attend.

44. Please list the course content areas that you found to be the *most useful or relevant* to your 6.3 project (if none were, say so). Please be as specific as possible.

45. **If** you listed any content areas under item 44, explain *for each area listed* **why** you think it will be useful or relevant. Please be as specific as possible.

46. Please list the course content areas that you found to be the *least useful or relevant* to your 6.3 project (if all areas were, say so). Please be as specific as possible.

47. **If** you listed any content areas under item 46, explain, *for each area listed,* **why** you think it will not be useful or relevant. Please be as specific as possible.

48. **If** you indicated that any content areas were not useful or relevant, please give any suggestions you have for making that particular content more useful or relevant to your 6.3 project. If any given area cannot be made useful or relevant, say so.

49. Apart from anything listed under item 46, would you change any other aspect of the course conduct or content if you could?

Yes ____ No ____

50. **If** you checked "Yes" for item 49, please explain as specifically as possible what you would change and how you would change it.

Thank you very much for your assistance in evaluating this IPPD initiative. Please call Jerry Barucky or Gary Grimes (at 1- 800 374-6601) with any questions or comments.

APPENDIX B: INTERVIEW SESSION DISCUSSION QUESTIONS

IPPD FOLLOW-UP INTERVIEW

1. Describe the manner in which your implementation of IPPD has been organized or directed.

   a) Has your IPT split into sub-groups to handle specific issues or does everyone work together?

   b) Have you had meetings to work on IPPD methods, plan implementation, or discuss status? How frequently?

   c) Are team members left on their own to implement as they see opportunities?

   d) Are certain team members more involved with IPPD implementation and others far less involved? Which members are the key IPPD implementers?

2. Are you satisfied with the level of communication within your IPT?

   a) How do you communicate about IPPD implementation?

   b) How often?

   c) What could be done to improve?

3. Are there specific requirements placed on your IPT by your "customer" or "customers" that make IPPD more difficult to apply to your project? If so, what are they?

4. Describe the extent or the manner in which the "users" or "customers" of the resultant technology have been involved in any IPPD discussions (e.g., helping lay out requirements parameters for the House of Quality).

5. What role have the contractors played in the implementation of IPPD? Attended training; involved in development of HOQ, technology worksheets, value scorecard, or other IPPD procedures? Is IPPD implementation a part of the deliverables in the contract?

6. How has the implementation of IPPD affected your time and resources allocated to the completion of the project? Has it resulted in savings of any kind? Has it taken away from time and funds that would normally be devoted to the task completion?

7. What beneficial aspects have occurred from implementation of IPPD? (e.g., more interaction among team members? forced to really look hard at performance parameters and consider a broader set of perspectives? more careful consideration of potential alternatives? knowledge gained in designing experiments for testing?)

8. Is it clear what specific actions and outcomes you should be able to demonstrate as a result of the implementation of IPPD?

a) Do you think the Air Force should specifically state what they expect from your IPT regarding IPPD; or would you rather set expectations yourself?

b) Do you understand the Air Force's expectations?

c) What do you think the Air Force expects out of the IPPD movement?

9. What criteria does your team currently use to measure performance and/or success of IPPD implementation?

10. Tell me what IPPD procedures and tools you've actually used in your 6.3 pilot project.

a) Have you completed an HOQ? Are you working on one?

b) Has your project identified alternative methods or processes or parameters that might result in tradeoffs in performance, cost, producibility, maintainability, etc. Have you collected data or run experiments? Have you developed performance, cost, or producibility worksheets to document examination of those alternatives?

c) Has your IPT developed a Value Scorecard to summarize the results of the consideration of alternatives?

d) Describe a specific example in which the use of IPPD processes was particularly helpful or in which they were applied successfully.

e) Describe a specific example in which the attempted application of IPPD processes was particularly difficult or was not successful .

11. To what extent is the technical support needed for implementation of IPPD procedures? (Does team make progress in IPPD without support of Peisert or other contracted advisors, or is their help essential at this point in the building of HOQ, development of worksheets, etc.?)

12. When the questionnaire asked about management support, what level of management were you referring to: Division, Directorate, Lab, or some other?

13. What are the probable outcomes of this overall IPPD initiative in the S&T community? (Do you think IPPD techniques will lead to actual increases in efficiencies and effectiveness in your or other projects? is it just a tool to measure and document what you are currently doing without changing the outcomes?, or is it likely to be a temporary managerial issue that will eventually fade in importance?)

APPENDIX C: FOLLOW-UP QUESTIONNAIRE

Follow-up Questionnaire

Name: _____

Organization: _____

Commercial Telephone: _____

Email Address: _____

Date Course was taken: _____

Instructions: This questionnaire gathers information that will be used to evaluate and refine the Affordable Technology/Integrated Product & Process Development, AT/IPPD, (previously known as Design for Six Sigma Manufacturing, or DSSM) initiative in the Air Force's Science and Technology (S&T) environment. For the purposes of this evaluation, IPPD will refer to both DSSM and AT/IPPD. A full evaluation effort requires extensive information not only about the use and effectiveness of training and mentoring programs, but also about how and how well the IPPD process is/has been implemented across pilot projects and the obstacles that make the process difficult to implement. We, therefore, requested verification of your name and other information so that we can follow up on this questionnaire if necessary. <u>We will not provide or report identifiable individual responses to anyone.</u> Select the MOST correct response. Whenever an item refers to "your 6.3 project," assume that it refers to the pilot 6.3 project to which the IPPD process is being applied. If you are not a pilot team member, assume it refers to your current project. Place additional write-in comments at the end of this questionnaire.

1. Are you currently either working on or in some substantial way connected with one of the IPPD 6.3 pilot projects?

   Yes ____ No ____

1a. Answer <u>only</u> if you answered "no" to question 1: Since you are <u>not</u> currently working on or in some substantial way connected with one of the IPPD 6.3 pilot projects, please briefly explain why you're no longer with the project, or why you previously attended an IPPD training course.

_____

_____

1b. Which pilot program are you currently assigned to as an integrated product team member? (circle)

a. 3DOC
b AMD
c. BWS
d. RCM
e. STD
f. NGT
g. CAI
h. ISCP
i. MASS
j. ALEP
k. LCCAAS
l. VEIITS
m. OHRDTP
n. Other _____
o. Not a member of any IPPD pilot program

2. Which response best describes your employment category?

Government ____ Contractor ____ Other ____ Please explain briefly below
(Military or civil service) (If you consider yourself a customer or user for 6.3 program, please say so.)

_____

3. Which of the following best describes your current position relative to the IPPD project you're working on (circle one):

a. Technical Manager
b. Technical Supervisor
c. Administrative Manager
d. Administrative Supervisor
e. Researcher
f. Bench Level Engineer
g. Scientist
d. Contracting Officer
e. Other (please describe briefly):

_____

4. Indicate the extent of your present knowledge about IPPD concepts and methods.

1	2	3	4	5
No knowledge	Small amount	Moderate amount	Large amount	Very large amount of knowledge

5. To what extent do you presently understand the reasons for the IPPD initiative?

1	2	3	4	5
No understanding	Slight understanding	Moderate understanding	Good understanding	Excellent understanding

6. To what extent do you presently understand the intended benefits of the IPPD initiative ?

1	2	3	4	5
No understanding	Slight understanding	Moderate understanding	Good understanding	Excellent understanding

7. To what extent do you presently understand how IPPD methods apply to your 6.3 program?

1	2	3	4	5
No understanding	Slight understanding	Moderate understanding	Good understanding	Excellent understanding

8. In general, to what extent has ***your team*** been able to apply the IPPD process, methods, and techniques to your project?

0	1	2	3	4	5
Don't know	Not at all	Slight	Moderate	Large	Very large extent

9. To what extent have ***you*** participated in the overall application of the IPPD process to your project?

1	2	3	4	5
Not at all	Slight	Moderate	Large	Very large extent

10. To what extent has ***your team*** completed a house of quality, HOQ, for your IPPD project?

0	1	2	3	4	5
Don't know	Have not/ Just begun	Quarter, 25%	Half, 50%	Three Quarters, 75%	Completed

11. To what extent did ***you*** participate in completing a house of quality, HOQ, for your IPPD project?

1	2	3	4	5
Did not	A slight amount	Moderately	Significantly	Most prominent contributor

12. To what extent has ***your team*** used technology worksheets to develop/investigate potential alternatives in terms of their costs and likelihood of success, producibility or failure?

0	1	2	3	4	5
Don't know	None of the time	A little of the time	Half of the time	Most of the time	Always

13. To what extent did ***you*** participate in using technology worksheets to develop/investigate potential alternatives in terms of their costs and likelihood of success, producibility, or failure?

1	2	3	4	5
Did not	A slight amount	Moderately	Significantly	Most prominent contributor

14. To what extent has ***your team*** used value scorecards to determine the best alternatives in terms of their likelihood of success, producibility, or failure?

0	1	2	3	4	5
Don't Know	None of the time	A little of the time	Half of the time	Most of the time	Always

15. To what extent have ***you*** participated in using value scorecards to determine the best alternatives in terms of their likelihood of success, producibility, or failure?

1	2	3	4	5
Did not	A slight amount	Moderately	Significantly	Most prominent contributor

16. To what extent has the use of IPPD methods helped ***your team*** reduce costs?

0	1	2	3	4	5
Don't know	Not at all	Slightly	Moderately	Large extent	Very large extent

17. To what extent has the use of IPPD methods helped ***you*** reduce costs?

1	2	3	4	5
Not at all	Slightly	Moderately	Large	Very large extent

18. To what extent has the use of IPPD methods helped ***your team*** shorten timelines?

0	1	2	3	4	5
Don't know	Not at all	Slightly	Moderately	Large	Very large extent

19. To what extent has the use of IPPD methods helped ***you*** shorten timelines?

1	2	3	4	5
Not at all	Slightly	Moderately	Large	Very large extent

20. To what extent has the use of IPPD methods helped ***your team*** increase productivity?

0	1	2	3	4	5
Don't know	Not at all	Slightly	Moderately	Large	Very large extent

21. To what extent has the use of IPPD methods helped ***you*** increase productivity?

1	2	3	4	5
Not at all	Slightly	Moderately	Large	Very large extent

22. To what extent has the use of IPPD methods helped ***your team*** identify risk associated with the project?

0	1	2	3	4	5
Don't know	Not at all	Slightly	Moderately	Large	Very large extent

23. To what extent has the use of IPPD methods helped ***you*** identify risk associated with the project?

1	2	3	4	5
Not at all	Slightly	Moderately	Large	Very large extent

24. To what extent are you aware of IPPD efforts/progress made by your IPT team members?

1	2	3	4	5
Not at all	Slightly	Moderately	Large	Very large extent

In items 25-32, use the 5-point scale below to indicate the amount that each of the following factors played in **hindering successful application of the IPPD process in your team project:**

1	2	3	4	5
Not at all	A slight amount	A moderate amount	A large amount	A very large amount

25. ___ Too many unknown or changing variables/conditions

26. ___ Our 6.3 project has special qualities or needs that are not amenable to the normal IPPD process.

27. ___ We were too far along in our project to employ the process with any worthwhile effect.

28. ___ Not enough time.

29. ___ Not have enough knowledge or training on IPPD methodologies.

30. ___ Not enough resources/materials available.

31. ___ Not enough support/emphasis from management.

32. ___ Write in, then rate, any other factor(s) that prevented successful application of the IPPD process.

_____

33. At what phase of a project do you believe it would be most beneficial to implement IPPD methods?

1	2	3	4	5
Start up		Halfway		Project Wrap-up
0-20%	21-40%	41-60%	61-80%	81-100% Completion

34. How much benefit do you think the IPPD process could be to 6.3 programs other than your current program?

1	2	3	4	5
No benefit	Small benefit	Moderate benefit	Large benefit	Very large benefit

35. How much does your management (collectively, not just any specific individual) know about IPPD **concepts and methods**?

0	1	2	3	4	5
I don't know	No knowledge	Small amount	Moderate amount	Large amount	Very large amount of knowledge

36. To what extent does your management (collectively, not just any specific individual) understand the **reasons for the IPPD initiative**?

0	1	2	3	4	5
I don't know	No understanding	Slight understanding	Moderate understanding	Good understanding	Excellent understanding

37. To what extent does your management understand the **intended benefits** of the IPPD initiative?

0	1	2	3	4	5
I don't know	No understanding	Slight understanding	Moderate Understanding	Good understanding	Excellent understanding

38. To what extent does your management understand how IPPD methods **apply** to your 6.3 program?

0	1	2	3	4	5
I don't know	No understanding	Slight understanding	Moderate Understanding	Good understanding	Excellent understanding

39. At the time you received your IPPD training, how did your management perceive that the **IPPD initiative could be successfully applied to your 6.3 program**?

0	1	2	3	4	5
I don't know	Application highly unlikely	Application unlikely	Chances about 50%	Application likely	Application highly likely

40. How does your management now think the IPPD initiative has been **applied to your 6.3 program**?

0	1	2	3	4	5
I don't know	Application nonexistent	Application weak	Application mediocre	Application successful	Application highly successful

41. At the time you received your IPPD training, what were your management's perceptions about IPPD methods resulting in **real benefits** to the 6.3 project?

0	1	2	3	4	5
I don't know	Real benefits highly unlikely	Real benefits unlikely	Chances about 50 %	Real benefits likely	Real benefits highly likely

42. To what extent does your management believe that the IPPD process has **brought real benefits** to the project?

0	1	2	3	4	5
I don't know	No benefit	Small benefit	Moderate benefit	Large benefit	Very large benefit

43. To what extent **did** management support your **attendance at your initial IPPD training**?

0	1	2	3	4	5
I don't know	No support	Slight support	Moderate support	Strong support	Very strong support

44. How much has your management actually supported your efforts to use IPPD methods?

0	1	2	3	4	5
I don't know	No support	Slight support	Moderate support	Strong support	Very strong support

45. How much has your management encouraged you to use **mentoring and/or take the available supplemental IPPD courses?**

0	1	2	3	4	5
I don't know	No support	Slight support	Moderate support	Strong support	Very strong support

46. How likely is it that **you** will use IPPD methods on future projects?

1	2	3	4	5
Application highly unlikely	Application unlikely	Chances about 50%	Application likely	Application highly likely

47. To what extent do **you** feel capable of applying the IPPD process in an appropriate program?

1	2	3	4	5
Not at all	Slightly capable	Moderately capable	Capable	Very capable

48. How much additional training or mentoring would you need before **you** would feel capable of applying the IPPD process.

1	2	3	4	5
No additional training	A slight amount	A moderate amount	A large amount	A very large amount

49. What other IPPD courses have you taken? (circle all that apply)

a. None
b. Design To Cost (DTC)
c. Design Of Experiment (DOE)
d. Design for Six Sigma Manufacturability (DSSM)
e. Other

---

50. Please estimate the total number of times and hours you've received mentorship from the course instructors.

Number of mentorship communications _____ Total hours of assistance _____

51. Apart from any potential benefit to your 6.3 pilot program, to what extent was the information provided in the course useful for your general professional development/ advancement in the future?

1	2	3	4	5
No use	Very little use	Moderate use	Quite useful	Extremely useful

52. Have <u>all</u> the <u>government</u> (military or civil service) members of your 6.3 project team taken the course? If you answer no, write in the approximate percentage of those who have attended.

Yes _____ No _____ Percent attended _____

53. Have <u>all</u> the <u>contractor</u> members of your 6.3 project team taken the course? If you answer no, write in the approximate percentage of those who have attended.

Yes _____ No _____ Percent attended _____

54. Do you think it is important that <u>all</u> the <u>government</u> members on your 6.3 project team take the IPPD course at the same time, or at some point?

Yes, at the same time _____ Yes, at some point _____ No, not important _____

55. Do you think it is important that <u>all</u> the <u>contractor</u> members on your 6.3 project team take this course **at the same time as the government members**, or at some point?

Yes, at the same time _____ Yes, at some point _____ No, not important _____

56. Do you think it is important that **all** team members attend IPPD courses or just certain "key" members?

All team members _____ Key individuals only _____

57. Would you recommend that your colleagues (those who do the same general kind of work you do but are not involved in a pilot 6.3 program) take this course?

0	1	2	3	4	5
No	Yes, it will provide a little benefit		Yes, it is appropriate for some		Yes, strongly recommend they take it

58. Who is/would be in the best position to evaluate IPPD effectiveness in your project?

Team members _____ Program Manager _____ Branch/Division Chief _____
Lab Director _____ Other _____

59. Do **you** feel your program has benefited from using IPPD methods?

1	2	3	4	5
No	Slightly	Moderately	Greatly	Excellently

Briefly explain why/how you think your program has benefited.

60. How did you measure the product/process improvements attributed to IPPD methods used in your project as compared to other methods used?

61. Has the working environment or processes where you work changed as a result of your IPPD training?

_____ No _____ Yes (If yes, briefly state how)

Thank you very much for your assistance in evaluating this IPPD initiative. Your input will prove invaluable to our evaluation. Please call Jerry Barucky or Gary Grimes at 1-800 374-6601 with any questions or additional comments.

COMMENTS

APPENDIX D: SUMMARY OF PROCESSES USED SURVEY

SUMMARY OF PROCESSES USED IN PILOT IPT

(In each area, circle the option that best describes the process experiences or intentions for your pilot project. If none of the options sufficiently describe your situation, please write a short alternative description.)

User/Customer Interaction in IPT Activities

1. Requirements determined from previous interaction in research area; little additional customer involvement

2. Requirements outlined/discussed at general meetings and through documents outlining general needs (e.g., TPIPTs or deficiency documents such as ORDS); little continuous involvement in actual HOQ development or other requirements documentation sessions

3. Involved in determining requirements through general means described above and at initial specific meetings regarding the technology project; little continuous involvement in development of HOQ, Exit Criteria, or other requirements documentation sessions

4. Continuous involvement at initial sessions and in development of HOQ or other requirements documents

    a. little continuous involvement after this
    b. continuous involvement planned, but project not there yet

5. Continuous involvement in most aspects of IPT, even after requirements and or exit criteria were established

Clear Determination of Requirements

1. General requirements outlined from needs documents or meetings, but no formal documentation

2. Formal performance requirements developed and documented, but no exit criteria documented

3. Formal performance requirements developed and documented, and technology/engineering requirements also outlined and compared, but no exit criteria formally documented

4. Formal performance requirements developed and documented, technology/engineering requirements outlined, and exit criteria formally documented

House of Quality (HOQ) Documented

1. No House of Quality developed in determining requirements

2. Process for determining requirements used that had similar result as HOQ (please describe or give example)

3. HOQ begun and still working on it

4. HOQ completed

Technology/Design Alternatives/Options Compared

1. Decisions regarding technology/design alternatives based on assessments of experienced researchers, or current knowledge; little testing or data gathering required

2. Decisions regarding technology/design alternatives based on tests, experiments, and data gathered; little formal documentation of results

3. Decisions regarding technology/design alternatives based on tests, experiments, and data gathered; formal documentation using methods other than IPPD Technology Worksheets (please describe method)

4. Decisions regarding technology/design alternatives based on tests, experiments, and data gathered; formal documentation using IPPD Technology Worksheets

5. Project not at this point yet, but intentions are most likely to reflect description 1 2 3 4 above (please circle)

Value Analysis

1. Decisions based on general intuitive considerations of information relating to alternatives' pros and cons; no formal documentation of analysis process

2. Decisions based on general intuitive considerations of information relating to alternatives' pros and cons; documentation of analysis process used methods other than Value scorecards (please describe methods)

3. Decisions based on data relating to alternatives' performance, producibility, costs, etc.; documentation of analysis process used methods other than Value Scorecards (please describe methods)

4. Decisions based on data relating to alternatives' performance, producibility, costs, etc.; documentation of analysis process included use of Value Scorecards

5. Project not at this point yet, but intentions are most likely to reflect description 1 2 3 4 above (please circle)

Technology Transition Business Plan (TTBP)

1. TTBP not developed

2. TTBP developed summarizing cost, risk, benefits, and transition assessments arrived at through Value Scorecard, HOQ requirements, and other IPPD products

3. TTBP developed summarizing cost, risk, benefits, and transition assessments arrived at by means other than IPPD products

4. Project not at this point yet, but intentions are most likely to reflect description 1 2 3 above (please circle)

IPT IPPD IMPLEMENTATION SUMMARY

IPPD PROCESS/PROCEDURES

IPT	MGT SUPRT	CUST INTRA	RQMTS/ EXIT CRI	HOQ	COMP Alts/ 3 Tech Wksheet	VAL Anal Scorecd	Devel/ Demo	Devel TTBP
AMD								
ISCP								
WINDS								
IRCM								
OTH								
NGT								
MASS								
ALEP								
CAI								
VIVIDS								

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APPENDIX E

Tables of Questionnaire Responses by Pilot Group

Table E-1. Percent by Pilot Reporting Various Amounts of IPPD Experience

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Small	67%	72%	14%	60%	0%	86%	50%	71%	29%	67%
Moderate	22%	20%	34%	40%	100%	0%	33%	29%	29%	33%
Large to Very Large	11%	8%	52%	0%	0%	14%	17%	0%	42%	0%

Table E-2. Percent by Pilot Reporting Various Amounts of Pre-Training IPPD Knowledge

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Small	78%	68%	28%	80%	100%	43%	29%	100%	71%	100%
Moderate	11%	24%	48%	20%	0%	28%	57%	0%	15%	0%
Large to Very Large	11%	8%	24%	0%	0%	29%	14%	0%	14%	0%

Table E-3. Percent by Pilot Reporting Various Amounts of Post-Training IPPD Knowledge

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Small	0%	16%	3%	0%	0%	29%	0%	14%	0%	0%
Moderate	67%	52%	45%	80%	100%	14%	29%	57%	71%	67%
Large to Very Large	33%	32%	52%	20%	0%	57%	71%	29%	29%	33%

Table E-4. Percent by Pilot Reporting Various Amounts of Pre-Training Understanding of IPPD Initiative

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Slight	33%	64%	38%	40%	100%	29%	43%	100%	43%	33%
Moderate	33%	24%	28%	40%	0%	42%	14%	0%	14%	33%
Good to Excellent	34%	12%	34%	20%	0%	29%	43%	0%	43%	34%

Table E-5. Percent by Pilot Reporting Various Amounts of Post-Training Understanding of IPPD Initiative

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Slight	0%	12%	3%	0%	0%	0%	0%	0%	0%	0%
Moderate	33%	36%	31%	20%	100%	43%	0%	43%	43%	33%
Good to Excellent	67%	52%	66%	80%	0%	57%	100%	57%	57%	67%

Table E-6. Percent by Pilot Reporting Various Amounts of Pre-Training Understanding of IPPD Benefits

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Slight	33%	72%	48%	60%	100%	29%	43%	100%	57%	33%
Moderate	44%	16%	21%	20%	0%	28%	14%	0%	0%	33%
Good to Excellent	23%	12%	31%	20%	0%	43%	43%	0%	43%	34%

Table E-7. Percent by Pilot Reporting Various Amounts of Post-Training Understanding of IPPD Benefits

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Slight	0%	8%	7%	0%	0%	14%	0%	0%	0%	0%
Moderate	56%	32%	38%	20%	100%	29%	0%	43%	43%	33%
Good to Excellent	44%	60%	55%	80%	0%	57%	100%	57%	57%	67%

Table E-8. Percent by Pilot Reporting Various Amounts of Pre-Training Understanding of IPPD Application

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Slight	78%	76%	62%	80%	100%	57%	57%	100%	33%	67%
Moderate	0%	24%	31%	20%	0%	28%	0%	0%	33%	33%
Good to Excellent	22%	0%	7%	0%	0%	14%	43%	0%	34%	0%

Table E-9. Percent by Pilot Reporting Various Amounts of Post-Training Understanding of IPPD Application

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
None to Slight	22%	12%	21%	20%	0%	14%	0%	57%	17%	0%
Moderate	33%	60%	38%	60%	100%	29%	0%	28%	0%	67%
Good to Excellent	45%	28%	41%	20%	0%	37%	100%	14%	83%	33%

Table E-10. Percent by Pilot Reporting Pre-Training Perceptions of Likelihood of Successful IPPD Application

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
No Opinion	22%	36%	31%	20%	100%	14%	14%	29%	33%	33%
Highly Unlikely to Unlikely	44%	20%	24%	20%	0%	14%	15%	71%	33%	0%
50%	22%	24%	31%	40%	0%	43%	0%	0%	17%	67%
Likely to Highly Likely	12%	20%	14%	20%	0%	29%	71%	0%	17%	0%

Table E-11. Percent by Pilot Reporting Post-Training Perceptions of Likelihood of Successful IPPD Application

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Highly Unlikely to Unlikely	38%	0%	14%	0%	100%	0%	0%	100%	20%	0%
50%	37%	54%	52%	60%	0%	33%	14%	0%	0%	33%
Likely to Highly Likely	25%	46%	34%	40%	0%	67%	86%	0%	80%	67%

Table E-12. Percent by Pilot Reporting Pre-Training Perceptions of Likelihood of Achieving Benefits from IPPD

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
No Opinion	11%	44%	14%	20%	0%	14%	14%	29%	20%	33%
Highly Unlikely to Unlikely	55%	20%	31%	40%	100%	14%	29%	71%	20%	0%
50%	22%	24%	38%	40%	0%	43%	0%	0%	20%	67%
Likely to Highly Likely	12%	12%	17%	20%	0%	29%	57%	0%	40%	0%

Table E-13. Percent by Pilot Reporting Post-Training Perceptions of Likelihood of Achieving Benefits from IPPD

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Highly Unlikely to Unlikely	25%	8%	10%	0%	100%	0%	0%	100%	20%	0%
50%	50%	67%	52%	40%	0%	43%	14%	0%	0%	33%
Likely to Highly Likely	25%	25%	38%	60%	0%	57%	86%	0%	80%	67%

Table E-14. Percent by Pilot Reporting Post-Training Perceptions of Potential IPPD Benefits to Other Project

Values	Pilots								
	1	2	3	4	5	6	7	8	9
None to Small	22%	0%	3%	0%	0%	0%	0%	0%	0%
Moderate	56%	74%	45%	0%	100%	29%	43%	50%	0%
Large to Very Large	22%	26%	52%	100%	0%	71%	57%	50%	100

Table E-15. Percent by Pilot Reporting Post-Training Perceptions of Capability of Applying IPPD

Values	Pilots								
	1	2	3	4	5	6	7	8	9
Not to Slight	25%	25%	21%	60%	100%	29%	14%	29%	14%
Moderate	38%	54%	48%	40%	0%	28%	43%	43%	72%
Capable to Very Capable	37%	21%	31%	0%	0%	43%	43%	29%	14%

Table E-16. Percent by Pilot Reporting Post-Training Perceptions of IPPD Additional Training or Mentoring Needed

Values	Pilots								
	1	2	3	4	5	6	7	8	9
None to Small	22%	8%	14%	20%	0%	43%	29%	14%	14%
Moderate	45%	67%	62%	60%	0%	28%	71%	29%	72%
Large to Very Large	33%	25%	24%	20%	100%	29%	0%	57%	14%

Table E-17. Percent by Pilot Reporting Post-Training Perceptions of the Usefulness of IPPD For Professional Development

Values	Pilots								
	1	2	3	4	5	6	7	8	9
No Use	0%	0%	0%	0%	0%	0%	0%	0%	0%
Very Little	25%	11%	0%	0%	0%	0%	0%	29%	20%
Moderate	50%	22%	39%	20%	100%	60%	14%	0%	20%
Quite Useful to Extremely Useful	25%	67%	61%	80%	0%	40%	86%	71%	60%

Table E-18. Percent by Pilot Reporting Post-Training Perceptions of Management's Knowledge of IPPD Process

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Don't Know	0%	17%	7%	0%	0%	0%	14%	0%	14%	0%
None to Small	33%	50%	65%	60%	100%	29%	71%	57%	57%	100%
Moderate	56%	25%	21%	40%	0%	28%	15%	43%	29%	0%
Large to Very Large	11%	8%	7%	0%	0%	43%	0%	0%	0%	0%

Table E-19. Percent by Pilot Reporting Post-Training Perceptions of Management's Understanding of IPPD Initiative

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Don't Know	0%	21%	7%	0%	0%	0%	0%	0%	28%	0%
None to Slight	44%	50%	48%	40%	100%	14%	57%	43%	43%	100%
Moderate	34%	8%	28%	60%	0%	29%	43%	28%	0%	0%
Good to Excellent	22%	21%	17%	0%	0%	57%	0%	29%	29%	0%

Table E-20. Percent by Pilot Reporting Post-Training Perceptions of Management's Understanding of IPPD Benefits

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Don't Know	0%	21%	11%	0%	0%	0%	0%	0%	28%	0%
None to Slight	44%	40%	41%	60%	100%	0%	57%	43%	43%	67%
Moderate	34%	13%	31%	20%	0%	43%	43%	43%	14%	0%
Good to Excellent	22%	21%	17%	20%	0%	57%	0%	14%	15%	33%

Table E-21. Percent by Pilot Reporting Post-Training Perceptions of Management's Understanding of IPPD Application

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Don't Know	0%	21%	21%	0%	0%	0%	0%	0%	29%	0%
None to Slight	50%	50%	69%	60%	100%	0%	86%	71%	57%	100%
Moderate	25%	16%	10%	20%	0%	57%	14%	0%	0%	0%
Good to Excellent	25%	13%	0%	20%	0%	43%	0%	29%	14%	0%

Table E-22. Percent by Pilot Reporting Post-Training Perceptions of Management's Projections of Likelihood of Successful IPPD Application

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Don't Know	22%	50%	28%	40%	100%	14%	14%	14%	57%	0%
Highly Unlikely to Unlikely	22%	8%	21%	0%	0%	0%	0%	86%	29%	0%
50%	34%	21%	34%	60%	0%	29%	57%	0%	14%	67%
Likely to Highly Likely	22%	21%	17%	0%	0%	57%	29%	0%	0%	33%

Table E-23. Percent by Pilot Reporting Post-Training Perceptions of Management's Projections About Achieving Benefits from IPPD

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Don't Know	13%	50%	28%	40%	100%	29%	14%	43%	57%	0%
Highly Unlikely to Unlikely	25%	13%	21%	0%	0%	0%	0%	57%	29%	0%
50%	37%	17%	44%	60%	0%	28%	43%	0%	14%	67%
Likely to Highly Likely	25%	21%	7%	0%	0%	43%	43%	0%	0%	33%

Table E-24. Percent by Pilot Reporting Post-Training Perceptions of Management's Support of IPPD Attendance

Values	Pilots									
	1	2	3	4	5	6	7	8	9	10
Don't Know	0%	4%	10%	20%	0%	0%	0%	0%	0%	0%
No to Slight	22%	17%	7%	20%	0%	0%	14%	14%	14%	0%
Moderate	11%	12%	24%	0%	100%	14%	0%	15%	43%	0%
Strong to Very Strong	67%	67%	59%	60%	0%	86%	86%	71%	43%	100%

Table E-25. Percent by Pilot Reporting Amount of Knowledge of IPPD Concepts, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
None to Slight	33%	18%	33%	6%	36%	0%	0%	11%	17%	20%	0%
Moderate	50%	76%	67%	50%	46%	67%	40%	22%	67%	40%	100%
Large to Very Large	17%	6%	0%	44%	18%	33%	60%	67%	16%	40%	0%

Table E-26. Percent by Pilot Reporting Levels of Understanding of IPPD Initiative, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
None to Slight	17%	6%	0%	6%	27%	0%	0%	11%	0%	0%	0%
Moderate	16%	59%	33%	12%	18%	33%	0%	0%	33%	0%	0%
Good to Excellent	67%	35%	67%	82%	55%	67%	100%	89%	67%	100%	100%

Table E-27. Percent by Pilot Reporting Levels of Understanding of IPPD Benefits, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
None to Slight	33%	12%	33%	0%	27%	0%	0%	11%	0%	0%	0%
Moderate	17%	47%	33%	19%	36%	33%	40%	78%	33%	20%	0%
Good to Excellent	50%	41%	34%	81%	37%	67%	60%	11%	67%	80%	100%

Table E-28. Percent by Pilot Reporting Levels of Understanding of IPPD Application, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
None to Slight	50%	23%	67%	6%	36%	33%	0%	0%	83%	40%	0%
Moderate	33%	65%	33%	44%	37%	67%	60%	22%	0%	0%	100%
Good to Excellent	17%	12%	0%	50%	27%	0%	40%	78%	17%	60%	0%

Table E-29. Percent by Pilot Reporting Extent Capable of Applying IPPD, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Not to Slightly	50%	47%	67%	25%	46%	33%	0%	11%	33%	20%	25%
Moderately	33%	47%	33%	50%	36%	0%	40%	11%	50%	40%	50%
Capable to Very Capable	17%	6%	0%	25%	18%	67%	40%	78%	17%	60%	25%

Table E-30. Percent by Pilot Reporting Additional IPPD Training or Mentoring Needed, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
None to Slight	33%	12%	0%	25%	30%	67%	80%	44%	33%	80%	25%
Moderate	33%	53%	67%	50%	60%	33%	20%	56%	67%	10%	75%
Large to Very Large	34%	35%	33%	25%	10%	0%	0%	0%	0%	0%	0%

Table E-31. Number by Pilot Reporting Various Amounts of Mentoring Communications

Number Of Communications Reported	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
0	6	5	2	14	7	1	2	7	5	2	3
1		2	1							3	
2		2							2		1
3		3		1		1	2				
4		2			1	1					
6		2			1			2			
8					1						
10							1				
16				1							
20					1						

Table E-32. Percent by Pilot Reporting Management's Knowledge of IPPD Concepts and Methods, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	0%	6%	33%	05	0%	0%	20%	0%	50%	0%	0%
None to Small	83%	53%	33%	56%	56%	67%	0%	33%	33%	60%	50%
Moderate	17%	29%	34%	6%	36%	33%	60%	56%	17%	40%	25%
Large to Very Large	0%	12%	0%	37%	9%	0%	20%	11%	0%	0%	25%

Table E-33. Percent by Pilot Reporting Management's Understanding of How IPPD Methods Apply to Projects, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	05	6%	0%	6%	0%	0%	20%	22%	50%	0%	0%
None to Slight	83%	65%	100%	56%	45%	100%	20%	22%	33%	40%	25%
Moderate	17%	23%	0%	25%	46%	0%	20%	45%	0%	20%	25%
Good to Excellent	0%	6%	0%	13%	9%	0%	40%	11%	17%	40%	60%

Table E-34. Percent by Pilot Reporting Management's Levels of Success of IPPD Application, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	17%	23%	0%	19%	27%	33%	40%	33%	67%	20%	25%
Weak to Nonexistent	83%	41%	67%	48%	27%	0%	20%	11%	33%	60%	75%
Mediocre	0%	29%	33%	18%	28%	33%	0%	22%	0%	20%	0%
Successful to Highly Successful	0%	7%	0%	18%	19%	34%	40%	34%	0%	0%	0%

Table E-35. Percent by Pilot Reporting Management's Extent of Benefits from IPPD, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	16%	35%	0%	19%	27%	0%	60%	44%	50%	20%	25%
None to Small	67%	65%	66%	50%	46%	66%	20%	0%	50%	60%	75%
Moderate	17%	0%	0%	19%	27%	34%	20%	44%	0%	20%	0%
Large to Very Large	0%	0%	34%	12%	0%	0%	0%	12%	0%	0%	0%

Table E-36. Percent by Pilot Reporting Management's Support for Initial IPPD Training Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	16%	0%	0%	6%	0%	0%	0%	0%	16%	0%	0%
None to Slight	16%	6%	0%	25%	0%	0%	0%	0%	17%	0%	0%
Moderate	17%	35%	33%	57%	0%	0%	20%	22%	50%	20%	75%
Strong to Very Strong	50%	59%	67%	12%	100%	100%	80% 78%	78%	17%	80%	25%

Table E-37. Percent by Pilot Reporting Management's Support for Supplemental Training or Mentoring Use, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	17%	0%	0%	19%	20%	0%	0%	22%	17%	0%	0%
None to Slight	17%	37%	0%	50%	50%	33%	60%	0%	16%	60%	50%
Moderate	33%	31%	67%	19%	0%	33%	20%	33%	50%	20%	25%
Strong to Very Strong	33%	32%	33%	12%	30%	34%	20%	45%	17%	20%	25%

Table E-38. Percent by Pilot Reporting Management's Support for Use of IPPD Methods, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	16%	6%	0%	0%	9%	0%	0%	11%	33%	0%	0%
None to Slight	67%	44%	33%	19%	55%	0%	0%	22%	33%	40%	50%
Moderate	0%	19%	33%	50%	9%	67%	60%	22%	17%	40%	25%
Strong to Very Strong	17%	31%	34%	31%	27%	33%	40%	55%	17%	20%	25%

Table E-39. Percent by Pilot Reporting Extent IPPD Use Benefited Their Program, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
None to Slightly	100%	71%	100%	56%	64%	33%	20%	25%	100%	100%	100%
Moderately	0%	29%	0%	25%	27%	67%	60%	63%	0%	0%	0%
Greatly to Excellently	0%	0%	0%	19%	9%	0%	20%	12%	0%	0%	0%

Table E-40. Percent by Pilot Reporting Extent IPPD Could Benefit Other 6.3 Programs, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
None to Small	17%	18%	67%	6%	18%	0%	0%	0%	0%	40%	25%
Moderate	50%	41%	33%	44%	37%	33%	60%	44%	20%	40%	25%
Large to Very Large	33%	41%	0%	50%	45%	67%	40%	56%	80%	20%	50%

Table E-41. Percent by Pilot Reporting IPPD Helped Reduced Costs, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	17%	53%	0%	25%	55%	100%	80%	50%	0%	0%	25%
Not at All to Slight	83%	41%	100%	56%	36%	0%	20%	50%	100%	60%	75%
Moderate	0%	0%	0%	6%	9%	0%	0%	0%	0%	40%	0%
Large to Very Large	0%	6%	0%	13%	0%	0%	0%	0%	0%	0%	0%

Table E-42. Percent by Pilot Reporting IPPD Helped Shorten Timelines, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	17%	35%	33%	38%	55%	100%	20%	37%	0%	0%	25%
Not at All to Slight	83%	59%	67%	37%	36%	0%	60%	63%	100%	100%	75%
Moderate	0%	6%	0%	25%	9%	0%	20%	0%	0%	0%	0%
Large to Very Large	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table E-43. Percent by Pilot Reporting IPPD Helped Increase Productivity, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	17%	41%	0%	12%	45%	0%	0%	38%	0%	0%	25%
Not at All to Slight	83%	53%	100%	44%	46%	0%	60%	50%	100%	80%	75%
Moderate	0%	6%	0%	25%	9%	100%	40%	12%	0%	20%	0%
Large to Very Large	0%	0%	0%	19%	0%	0%	0%	0%	0%	0%	0%

Table E-44. Percent by Pilot Reporting IPPD Helped Identify Risks, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Don't Know	17%	23%	0%	6%	36%	0%	20%	12%	0%	0%	25%
Not at All to Slight	66%	53%	66%	50%	36%	66%	20%	25%	100%	60%	75%
Moderate	17%	24%	34%	25%	28%	34%	40%	63%	0%	40%	0%
Large to Very Large	0%	0%	0%	19%	0%	0%	40%	0%	0%	0%	0%

Table E-45. Percent by Pilot Reporting IPPD Course Useful for Professional Development, Months After Training

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
No Use to Very Little	17%	12%	0%	6%	18%	33%	20%	11%	0%	20%	0%
Moderately Useful	68%	47%	100%	56%	46%	67%	40%	22%	50%	20%	50%
Quite to Extremely Useful	16%	41%	0%	38%	36%	0%	40%	67%	50%	60%	50%

Table E-46. Percent by Pilot Reporting Importance of All Government Members Attending Course

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Not Important	33%	23%	0%	31%	22%	0%	80%	0%	17%	20%	0%
Yes, At Some Point	17%	12%	67%	44%	67%	33%	0%	67%	33%	60%	50%
Yes, At Same Time	50%	65%	33%	25%	11%	67%	20%	33%	50%	20%	50%

Table E-47. Percent by Pilot Reporting Importance of All Contractors Attending Course

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
Not Important	17%	18%	0%	47%	9%	0%	80%	0%	17%	40%	0%
Yes, At Some Point	0%	35%	67%	40%	45%	33%	20%	56%	33%	20%	50%
Yes, At Same Time	83%	47%	33%	13%	46%	67%	0%	44%	50%	40%	

Table E-48. Percent by Pilot Recommending IPPD Course for Colleagues on Other Projects

Values	Pilots										
	1	2	3	4	5	6	7	8	9	10	11
No	0%	12%	0%	0%	18%	0%	20%	0%	17%	40%	0%
Will Provide A Little Benefit	50%	47%	33%	25%	18%	0%	20%	11%	16%	20%	50%
Appropriate For Some	33%	41%	67%	50%	37%	100%	60%	67%	67%	20%	25%
Strongly Recommended	17%	0%	0%	25%	27%	0%	0%	22%	0%	20%	25%

APPENDIX F: SUMMARY OF IPPD APPLICATION EXPERIENCES OF PILOT IPTS

SUMMARY OF IPPD IMPLEMENTATION IN THE PILOT PROJECTS: BASED ON TEAM MEMBERS' PERCEPTIONS FROM FOLLOW-UP INTERVIEWS

The following pages summarize the researchers' perceptions of the IPPD implementation experience among the 11 pilot projects for which implementation was possible. These summaries are based on small group and telephone follow-up interviews with IPT members. Program managers have reviewed the summaries to correct erroneous interpretations of interview comments and to check for accuracy in terminology.

3-DOC (3-Dimensional Optical Computing Memory): This project is attempting to develop a computer memory storage device the size of a sugar cube, capable of storing, retrieving, and writing data at 10 to the 12^{th} power.

a. Interviewees: The researcher met with Bernie Clark, Fred Haritatos, Gary Sunada, Shay Capehart, Ed Daniszewski, and Al Jamberdino) in one group to discuss their progress using IPPD technologies.

b. Appropriateness for IPPD: The group members indicated that their project was in too much of an early conceptual stage to employ the IPPD procedures. They suggested that the process would be more appropriate at a later stage.

c. IPPD Organization/Activities: The group has used few of the IPPD procedures. They determined that IPPD procedures did not fit their idea of how to approach the 3-DOC research project at this early stage of development. They said that many of their team members have been engaged in this type of research for 20 years and could make the early decisions based on their intuitive understanding and experience. They said that they were using a common sense approach that IPPD utilizes (working with customers and evaluating different alternatives in terms of performance and cost), but they didn't see the utility of documenting their activities in the detailed manner that IPPD demands. In addition they claim there are no alternative suppliers for some of the technologies they're working with, so there is less demand for testing alternative approaches. They felt the attempt to adapt these procedures to their project would require additional time and resources which had been in increasingly short supply because of a sizeable loss of some of their funding. The team members indicate they have good internal communication because their offices are located together, and they say they have frequent interaction with ACC and AIA representatives who will be their customers.

d. Measuring Success: They have not established IPPD measures of success. Their goal is to provide an effective product for their customers at a reasonable cost. They would like to achieve 10 to the 12^{th} data storage and retrieval, but indicated that customers will be happy to get whatever they can produce.

e. Observations: The group indicated that part of their motivation for volunteering for IPPD was the possibility of securing additional funding. However, when they found out what

IPPD really was and the difficulty of applying it at their stage, they were less willing to participate because it could cause potential delays. Since the team felt IPPD implementation would take time and resources away from the mainstream research and these costs would have to be absorbed, they saw it would actually have an opposite effect on their project. Thus, IPPD procedures were not employed.

ALEP (Advanced Laser Eye Protection): This IPT is working an area of research to improve laser eye protection (LEP) for aircrew members. Their job is to examine various dyes and technologies that will enable flight crews to perform all aspects of their flight mission and still protect them against laser effects. Their focus has been on the near-term approaches to laser eye protection, involving fixed wavelength materials and technologies.

a. Interviewees: The researcher met with project representatives at two locations over four sessions.

b. Appropriateness for IPPD: As the laser eyewear protection project is one of the most 6.3-oriented programs in the Air Force Research Laboratory, Materials and Manufacturing Directorate (AFRL/ML), it was a better candidate for IPT selection. It also offered a variety of alternative requirements and potential approaches that could be considered using IPPD procedures. However, as it has been an ongoing program for several years, it may have been more difficult to introduce a new research approach into a team that has been doing business its standard way for many years. Despite this potential obstacle, the Program Manager indicates that their IPT members seemed relatively willing to adapt.

c. IPPD Organization/Activities: This project is divided among two separate lab groups: the Hardened Materials Branch at AFRL/ML at Wright Patterson AFB, and the Human Effectiveness Directorate (AFRL/HED) at Brooks AFB. Primarily the ML group coordinates with contractors to produce the eyewear products, and the HED group, including TASC contractors, carries out the physical, psychophysical, and human factors testing of the product. This division of labor clearly requires greater coordination and understanding of each group's perspective in order to have an effective consolidated effort. In short, the HED group sees itself as more near-term, product evaluation-oriented, emphasizing produceability, cost goals, and manufacturability. The ML group, which has been involved with and supported production-oriented activities such as tooling, scale-up, and development of product evaluation methodologies, is still somewhat more involved with answering some long-term technology questions. A good deal of time has been devoted to developing a common vision of objectives and roles among members of the Brooks and Wright-Patterson team.

One organizational difficulty in this project was the limited System Program Office (SPO) involvement because the Life Support SPO did not have anyone technically competent to cover laser eyewear. Now the TASC representatives are facilitating the user interface to determine requirements. This becomes compounded because there are a large number of potential customers from different operational missions, aircraft types, and cockpit environments. Their varying needs make it more difficult to fix on a set of performance requirements and factors or conditions to consider for testing. Representatives from a SPO and using commands were not present at the development of an initial listing of potential program objectives that occurred just after the IPPD training course in May 97. Nor were they present at the earliest HOQ development sessions, as the project staff felt having them involved in detailed negotiations of performance requirements would have been a poor use of the users' time. The researchers

indicate that the Operational Requirements Documents (ORD) and the LEP body of work over the years have provided enough user feedback to have a good idea of the users' perspective.

The major contractors (Kaiser and Rockwell) were also not involved much in selecting the project requirements or initial building of the HOQ. However, some of their representatives had attended the IPPD and DOE training sessions. Project members from ML indicate they spent considerable time keeping users informed at tactics conferences and providing technology demonstrations and briefings at using commands. The research staff plans to involve contractors and customers more in the next IPPD stages as they finalize the HOQ and determine the extent to which they will be able to test the potential technologies.

By November, the ML group had met as an IPT on five occasions and in joint sessions with the AL group four times, including a kick-off meeting and a planning session on the day after IPPD training. They are planning to have an IPPD refresher session with all team members and then continue to refine the HOQ. They have not yet implemented the Technology Worksheets and Value Scorecard procedures. A number of tests of technology will have to be developed by the team and conducted by AL to get answers on various technology options. It is not clear whether the contractors will be able to devote the time and resources needed to test all those options so they can fully employ IPPD documentation.

d. Measuring Success: Both groups indicated the requirements for assessing the success of IPPD efforts were initially not very clear. The AF desired outcomes have been made somewhat clearer as TARA presentation requirements have been made known. Wright Laboratory (WL) staff feel they will need to demonstrate the use of specific IPPD procedures.

e. Observations: Team members indicate that participation in the IPPD initiative has had some positive benefits, primarily in bringing the two groups together to decide on a common perspective. The laser protection requirements profiles, means for quantifying those requirements, and exit criteria have been established and would have been accomplished without IPPD procedures. However, the PM suggests that the IPPD methodology provided a more structured approach to accomplishing these objectives and also provided a valuable documentation trail.

There is also a belief, among most team members, that the use of IPPD procedures (as well as being a pilot team) has come with a large amount of overhead in terms of briefings, meetings, and documentation. It is still a question of whether additional benefits that may be obtained from the structured value analysis will offset the costs of detailed data collection and extensive testing that could be required for a full implementation of IPPD.

Many of the costs associated with IPPD implementation, at least in this pilot phase, have had to come out of the project funding. The desire to fully implement the IPPD process, with all potential tests, bumps up against the reality of no additional funds. In the future, as the IPPD learning curve is smaller, these additional costs may be less, and they will be built into the original project funding estimates.

AMD (Advanced Motor Drive) This project is developing an electromechanical actuator (as opposed to a hydraulic system) with an emphasis on the motor drive for a spoiler surface of a transport aircraft.

a. Interviewees: The researcher met with Greg Fronista (the Program Manager) and Earl Gregory. Both had taken the DSSM course at TILI in May 1996. One other team member who had participated in the IPPD training, a contractor from Sundstrand, was not available for interviewing. The PM indicated that there were actually nine members on the IPT, but only those three had attended the DSSM or IPPD course.

b. Appropriateness for IPPD: One difficulty associated with application of IPPD methods in this IPT is that the project was already well underway when it was selected as an IPT. The preliminary design was already complete, and team members actually looked back at previous decisions to determine if appropriate decisions had been made. Greg feels the project was selected because of its complexity and because the contractor, Sundstrand, had a strong manufacturing base and some low-level experience with basic IPPD principles.

c. IPPD Organization/Activities: Greg was the main government player, and he met with four contractor representatives at Sundstrand every two weeks for several months to determine how they would employ IPPD processes. Meetings included all IPPD players, but not all of the IPPD team members were IPPD trained. James Gregory trainers were at all these Sundstrand sessions. One TI mentor also sat in on a DOE session at Sundstrand. They also communicated through phone, fax, and mail, but felt face-to-face sessions kept key players well connected.

During these meetings the IPT developed an HOQ, performed a designed experiment (Taguchi 3-factor, 2-level design) to evaluate a new approach to concurrent design during S&T. Data was generated using an EMA simulation application at Sundstrand. A model was developed relating deployment rate for a large spoiler surface. In addition, a tolerance analysis was done for the Phase II controller electronics, using a tool developed for the S&T IPPD process and distributed during the AT/IPPD course. Sundstrand engineers were enthusiastic about using that tool.

Implementation of value analysis aspects of the IPPD process was more difficult. The project was far enough along that the IPT had to recreate the rationale for their decisions. They had done some simulations of motor design options to test those options, but the choice of motor type (switch reluctance) was made because of its fault tolerance and cost considerations. The IPT used similar existing knowledge or general data to compare performance, producibility, and cost tradeoffs, but the decisions were not documented using technology worksheets or a value scorecard.

d. Measuring success: Greg could name no specific criteria for judging "success" of IPPD efforts. They felt the primary concern was to show they were making an effort to employ IPPD procedures

e. Observations: Having to apply IPPD procedures retrospectively to already completed decisions was like running two programs and doubled some of the workload on this project. They discovered that many of the considerations identified by the IPPD process had been informally considered and accomplished originally, but they were not recognized and documented as part of a formal affordability determination process

– It is important to have a critical mass of team members knowledgeable enough about IPPD to come to some decisions about its use. On some decisions the contractor was IPPD-knowledgeable and the activity was right for employment of the IPPD process, but the rest of the

actors at the meeting weren't as knowledgeable, the attempt to introduce IPPD processes bogged down, and the initiative was lost. They suggest most team members should have at least a basic level of IPPD training.

– It is most important for contractors to be IPPD-capable and convinced it is worth the effort. They are not sure Sundstrand's totally convinced yet that the process can be applied to 6.3 programs. Demand for affordability measures should be written into contracts so capability in that area and incentive to demonstrate employment of IPPD procedures are built into the selection process.

– They felt that, with the right combination of trained team members and the mentorship provided by the training team, they could have implemented the process successfully from the beginning of the project.

– They were most comfortable with building the House of Quality and thought that procedure ought to be applied to most 6.3 programs to help members thoughtfully lay out requirements.

– In some other decisions, the various players' competing interests related to affordability made it difficult to reach agreements (e.g., SPOs want return on investment over a few years, providing more incentive to hold down acquisition costs at expense of life-cycle costs).

– They suggested that collection of data in some projects can be done through computer simulation and tools for that process need to be developed or made more available.

– Sundstrand had indicated that a rough-cut version of the IPPD cost vs risks and manufacturing vs maintaining considerations (available via an automated program) would help them justify programs and get them off the ground.

CAI (Composites Affordability Initiative): The CAI project consists of three associated programs designed to achieve a significant reduction in acquisition costs of aircraft structures through revolutionary utilization of composite materials. Two near-term programs (Tech Transition 1 and Tech Transition 2) focus on finding improvements for a specific, next generation fighter. This focus on near-term risk reduction means they have to fit proposed innovations into existing fighter configurations. A longer term "Pervasive" program affords a more open-ended review of all assumptions and aspects of structural-related materials, design, or processes that could affect the cost while maintaining quality of fighter aircraft of the future. In this program researchers are freer to question requirements and specifications and the usual ways of doing business.

a. Interviewees: The researcher met with five members of the IPT at Wright-Patterson AFB: Dave Beeler (PM), Diana Carlin, Dick Holzwarth, and Ken Ronald from AFRL/ ML, and Paul Hauwiller (project support contractor from Anteon). Most of the 29 team members who attended IPPD training were from the large group of contractors (Boeing, Lockheed-Martin, Northrop, McDonnell Douglas) and were queried via the follow-up survey. A telephone interview was also completed with Dee Gill., the Systems Engineering Team lead for the Pervasive program.

b. Appropriateness for IPPD: This program is somewhat challenging as an IPPD IPT because of the highly conceptual nature of its mission.

c. IPPD Organization/Activities: This program is more complex because it is divided into three separate but affiliated programs: T-1, T-2, and Pervasive. There is an overall Leadership IPT (LIPT) overseeing management, planning, and integration of the three subprograms. In turn, each program has an Activity IPT (AIPT). The Pervasive program is also subdivided according to tasks or functional areas (e.g., concepts, fabrication, assembly, testing, cost) with a systems engineering team (representing major stakeholders) reviewing the 10 task teams. In addition, there are both Navy and Air Force partners, four industrial partners, and numerous subcontractors.

Description of the IPPD status of the T-1 and T-2 programs is somewhat constrained by the need to protect proprietary information of the two competing design teams.

The initial introduction of the IPPD process was presented to the CAI LIPT in May 1997, and that group agreed to participate as an IPPD pilot. The AT/IPPD training was presented to 29 CAI members in mid-August 1997, and a one-day follow-on session with the training consultants was held to outline an IPPD implementation strategy. By that time, the first phase of the CAI program (getting organized and planning the structure and ground rules for team interaction and communication) had been ongoing for about a year. T-1 and T-2 held their kickoff in the summer of 1997. The Pervasive program was begun in December 1997.

The potential users/customers include both military and industry partners. Although the project focus is a military aircraft (JSF), with requirements input from potential users of that aircraft through the JSF SPO, commercial/industry contractors are potential users of the technology lessons derived, and are, therefore, significant stakeholders and active IPT members.

Although they did not specifically employ a House of Quality approach, the T-1 and T-2 teams have established milestones and exit criteria for each technology area. They have also begun some preliminary investigation of performance, cost, and risk alternatives for the various technology options. In doing so they have not used the technology worksheets demonstrated in the IPPD design analysis process. Rather they indicate they have found it effective to use other multi-attribute decision tools in implementing a more traditional trade studies approach. They suggest that they are in a conceptual stage that is less conducive to the use of the specific IPPD tools demonstrated in the training. At this stage of consideration of conceptual options there are often limited data pertaining to the actual performance or manufacturability of the technology concepts. They have used these data and a QFD approach to qualitatively assess differences between the various innovation concepts and to support decisions that will lead to down selection to a single design concept. Once they have selected a single concept, they will do more testing of the aspects of the design, collecting data to refine the design. Ultimately, when they have a more firm design, they will do the kinds of testing of its features for performance, risk, and producibility that may be more easily documented with the IPPD technology worksheets and value scorecard.

The Pervasive AIPT had a relatively broad mission of improving the use of composites in aircraft design by developing tools and technologies needed to achieve breakthrough reductions in cost and weight. Because they had the ability to look at all potential areas of structure design and manufacturing tools and processes, and the option to question all requirements/specs, the team needed to determine an initial area on which to begin focusing their efforts. Thus, in September, the Pervasive team began the process of determining areas of technology to focus on.

To accomplish this decision process they employed a modified HOQ, using a subjective rating system to compare potential technology investigation areas on several criteria, such as "pervasiveness" (utility across structural functions), impact on affordability, or risk for technology maturation. This process proved to be beneficial in requiring proponents of various candidate areas to demonstrate how their area met the decision criteria, and it provided a means of documenting their decision process. Both attributes demonstrated the utility of that type of structured approach to decision making that is typical of the IPPD process.

In the Pervasive project, IPT members have been working closely with training consultants to develop and try out new tools for implementing the IPPD procedures. For example, they have used a Desirability Factor metric to assist decision making in the House of Quality. They have been meeting frequently with the consultants trying to determine ways to quantify performance, cost, and producibility requirements. When they selected the 10 technology areas to focus on, they discovered the existent data were not as fully developed or had not been tested in as robust a manner as they'd have liked. They are currently doing trade studies using revised technology worksheets developed by the James Gregory consultants. Despite the fact that some of the Pervasive team members had IPD process experience in the F-18 and 777 production programs, few had experience using these procedures in an R&D environment. They are finding that they are having some difficulty applying the Six Sigma risk measures to their analyses of design options. They indicate that some processes they need to test are so new that no corresponding risk data exist, and it would be very costly to build a part and do the tests needed to gather data. Thus the use of the IPPD process is not a simple task, but they are working at it.

d. Measuring Success: The T-1 and T-2 teams, possibly because of time constraints, are more focused on the mission of identifying and testing means for acquisition cost reduction. They are concerned with measuring their accomplishment of these goals, feel their current processes are helping achieve them, and have devoted less energy to measuring the extent they have employed the IPPD procedures and to documenting their use. The Pervasive team has been able to go through the steps of developing means for employing the IPPD procedures, and they are assessing their progress in the use of the IPPD procedures as well as accomplishment of their mission. They suggest it is too early in their project to gauge the success of their implementation or the benefits derived.

e. Observations: It is obvious that the CAI project provides a good demonstration of the difficulty in implementing IPPD to very conceptual R&D projects and of the divided opinion regarding its utility at various stages of the research process. The Pervasive team seems to have both the time and commitment to stay with the IPPD process while the tools for its implementation are being worked out. They have indicated that the AT/IPPD course, as originally delivered, was full of applicable processes, but needed more pertinent examples and tools that would enable R&D personnel to carry out robust testing of alternatives and rigorous data-gathering required of the IPPD process. They indicated that the IPPD process still was useful in forcing the IPTs to work together off the same page, sharing insights and perspectives, and making data-based decisions rather than relying just on intuitive assessments of experienced researchers. They emphasized the requirement for training of all players, for extensive facilitation by credible experts after training, and for program managers that believe in the process and that will hold researchers accountable for providing credible data.

IRCM (Large Aircraft Infrared Countermeasures): This project has LIFE as its main program, seeking techniques to defeat the threat of heat-seeking missiles. All critical subsystems are being addressed by this project, with the early emphasis on the laser technology.

a. Interviewees: The researcher met with 12 members of the IPT over two different 90-minute sessions. Those participating included Mark Wunderlich (Program Manager), Darrin Coffman (Field Test Director), Bill Taylor, (Affordability Lead), Rich Hunziker (EO Division Chief), Joe Koesters (Branch Chief), Virginia McMillian, Cal Verity, and Jerry Dague, William Von Gunten, Stanley Herr, Adam Coleman, and Harold Watson from the SAIC contractors.

b. Appropriateness for IPPD: Participants suggested this project was amenable to IPPD because they know who the users are and have contact with them. The project had been seriously underway for six months prior to attendance of DSSM course in Oct 1996.

c. IPPD Organization/Activities: This process is relatively new to members of this project, and, except for Litton, laser contractors had also had little familiarity with this type of research process. Some contractors, (e.g., Lockheed-Martin and Sanders) attended DSSM and DOE training, and a number of team members will be attending the newer version of the IPPD course. Implementation activities for IPPD seem to be concentrated among certain IPT members. There had been several meetings called to review progress, but they weren't scheduled on a periodic basis or with a lot of lead time, and several members would miss them. Most of the laser aspects are being handled by the PM in conjunction with the Directed Energy Directorate and Lockheed contractors. AFRL/SN's representatives from the Laser Applications Branch attended the DSSM training but have had little involvement with the project. However, a key representative from Simulation and Modeling has not attended the training. Some participants suggested the number of members actively involved has been limited to save time and resources.

Right after the DSSM course in late 1996, a small group put the House of Quality together for the laser subsystem, relating customer requirements to technical requirements. This was done with the help of James Gregory consultants and meeting participants felt the effort was very beneficial. In fact, these requirements had been identified months earlier through strong customer interaction at a Systems Requirements Review. By the time the DSSM training had been provided, exit criteria had been established and the IPT had already gone to a Preliminary Design Review. A Technology Transition Plan (TTP) has been developed and reviewed with representatives of the C-17 SPO and Air Mobility Command.

However, further movement toward development of technology worksheets and a value scorecard and gathering the data for those decisionmaking tools has been slow. Affordability tradeoff metrics need to be established for the various performance requirements. The interviewees suggest the obstacle is not enough time and resources. Originally the IPT thought it would only be able to implement IPPD in one subsystem, but now they have reworked the contract to require the contractor to use IPPD to address affordability across all subsystems.

d. Measuring Success: They did not feel that specific outcomes from the IPPD implementation were identified for the IPTs. Therefore, they felt development of a HOQ and value analysis tools would show a good faith effort to implement IPPD procedures.

e. Observations: Participants who had been actively involved with the IPPD implementation reflected positively about the experience, suggesting it would have been

beneficial to employ the HOQ for the entire system and then work down to the subsystems. The impression is that the implementation is worked primarily among a few core players, and there is relatively little communication with/among others regarding IPPD status. Those who worked the implementation indicated it was necessary to have the consultants' assistance in the HOQ development.

Participants suggested it is important to have the contractors' initial buy-in to the IPPD process written into the contract. The demand on resources given to IPPD documentation and data-gathering are taken from the project, and contractors don't have additional funds beyond what is required to be spent on actual research work. Although there was initial uncertainty as to the overall payoff from the IPPD process, there seems to be a somewhat greater commitment of interest and corporate funds aimed at supporting the affordability issues.

A few of the participants suggested the process was not appropriate to 6.3 work . While most indicated it seemed appropriate, they admitted that they were still struggling with how exactly to apply it. However, most participants saw the potential general benefit from learning to look at the project beyond their own narrow, proof-of-concept and let-it-go perspective. They said it forces them to think about what happens later and about potential ramifications to producibility and later stages.

Those who had attended DOE training were very supportive of its benefits, suggesting it "should be a standard course for anyone coming to the lab." Others agreed but suggested the DOE information should be linked better to costs and affordability.

It was suggested that MANTECH participation should be funded earlier so they can work more as an integrated team

ISCP (Improved Space Computer Program): The ISCP project is actually part of a two-phase program to design computer architecture for a space-based computer system. The first phase, which kicked off in summer of 1996, was a contents analysis and definition phase. Two contractor teams did a space systems requirements analysis and computer architecture concept definition, looking at three DOD missions and surveying industry to determine the processing performance requirements for satellite systems in the near future. They looked at commercial available computer architecture that could be employed in one or more space systems, serving both low-end and high-end missions. Phase II, which is known as the Improved Space Architecture Concept, is designed to narrow down the potential architecture options to a recommended design. Although the Phase II RFP went out in the summer of 1997, a protest of the bidding process delayed the final awarding of the contract until April 1998.

a. Interviewees: The researcher conducted telephone interviews with the IPT program managers at Phillips Lab, Capt Joe Nedeau and his successor, Mr. Ken Hunt.

b. Appropriateness for IPPD: The PM indicated the first phase of the project, which was more focused on requirements definition, was not as appropriate for IPPD as the second phase, in which alternative architectures will be examined to determine the most appropriate for meeting a variety of space system missions at reasonable cost.

c. IPPD Organization/ Activities: Basically, the PMs indicated the IPPD procedures are to be employed much more in Phase II than they were in Phase I. In the first phase, the potential

using agencies were not as heavily involved as they might have been. The IPT had to project where core technologies and current systems are going, and, because this is more of a "tech push" program, the users had to be led to consider the potential uses of a space-based computer system. The requirements are aligned to Space Command deficiencies, but, in hindsight, the PM would have more actively sought the involvement of the Space and Missile Systems Center. The IPPD requirements were not in the first phase contract. Although the prime contractors attended DSSM training, few subs attended, and they indicated there would be a considerable overhead associated with IPPD implementation. Both teams developed a common set of customer performance requirements, and one team attempted to quantify their expected architecture performance. However, most decisions were intuitive, based on expertise and experience, and little other quantitative analysis, testing, or documentation using design worksheets was employed.

In the second phase, the IPPD requirements are clearly outlined in the contract, and training is to be paid for by AFRL. The kickoff is set for late May 1998, and four IPTs will oversee various aspects of the project. A web-site will be set up to connect contractor entities. The PM indicates the team will do spreadsheet analyses to filter out the least desirable architecture alternatives. They will use initial, low-level simulations and then more detailed, high-level simulations to narrow the final four alternatives to a best choice. They intend to use technology worksheets and value scorecards in their documentation of decisions and indicate they will also develop a technology transition business plan (TTBP) for each customer. Their intention is to have a software testbed capable of demonstrating the architecture's capability for processing.

d. Measuring Success: In the first phase, IPPD success was not emphasized, whereas in Phase II, use of IPPD procedures will be monitored.

e. Observations: It seems that this pilot team was not really prepared for IPPD employment in the first phase of the project, and had less IPPD commitment from one of its two competing contractors and several subs. The PM stressed the need to specify IPPD requirements in the contract, and he also indicated the need for additional guidance in outlining these factors contractually. In fact, he suggested that an S&T IPPD set of guidelines be developed for managers and key contracting leaders to help them administer and assess IPPD implementation. The planned improvements in the second phase indicate that the project personnel used the first phase as a learning experience.

MASS (Modular Aircraft Support System): This program is designed to develop an improved aerospace ground equipment (AGE) package that has a smaller footprint for deployment (is more reliable and maintainable and can be used across multiple aircraft types so less equipment is needed). Also a need for this improvement to be affordable is emphasized..

a. Interviewees: The researcher met with Matt Tracy (PM), Capt Dwight Pavek, and 1Lt John Schroeder, and had a telephone interview with David Hablanian (A.D. Little contractor).

b. Appropriateness for IPPD: Because the project was begun in conjunction with the IPPD initiative, IPPD supportive language was built into the contract and the contractor selected had some IPPD experience. In addition, the customers were well known and could help in establishing user requirements.

c. IPPD Organization/Activities: Fairly extensive use of integrated product teams with good representation by Wright Lab personnel, contractors (A.D. Little), and potential customers. IPT meetings and a web site have promoted good communication among government managers, contractors, SPOs, and users.

Prior to beginning of contract, James Gregory consultants met twice with MASS IPT, including system users to outline IPPD process and requirements and even attempted a first cut at a rough HOQ. Source selection in Fall of 96 included IPPD requirements, and contractor reps as well as AFRL/HE personnel attended IPPD training in May 97 and in September 97. The users, however have not had IPPD training The contractors reviewed the rough-cut HOQ and recommended modifications. Multiple users (including Army and Navy) were very involved in discussion of system requirements. This made matters more difficult because of differing views on needs and trade-off priorities. HOQ was continually revised as these different requirements were identified or changed and off-the-shelf parts and components were discovered. However, 10 months after training, the HOQ is fairly complete, with performance specs and technology requirements outlined.

By November 1997, there had been 4-5 review sessions, but many of the attendees did not have IPPD training, and that has hindered the progress that was initially experienced. At these sessions members worked to refine exit criteria for size and layout of AGE components. Reworking of the HOQ, reprioritization of requirements, and many discussions regarding tradeoffs based on what technology was doable given cost, time, and other requirements and constraints resulted in a configuration with six concepts. By April 1998 the team had identified a single concept that was actually a hybrid combination of the six.

In coming to this decision, development of technology worksheets and a value scorecard were appropriate procedures as a means of logically resolving some of the tradeoff debates. They made an attempt at developing a value scorecard but couldn't pull it off for several reasons: they (a) didn't have the technical ability to build it, (b) didn't feel they had sufficient data or the time and resources to gather those data, and (c) had difficulty convincing senior enlisted members of using agencies to accept this approach to making these decisions. They weren't ready to quantify each requirement and trade-off and were reluctant or unable to identify, collect, and consider the data related to life-cycle costs. The IPT team members contend there is no easy system in place for collecting data, such as parts usage or failure rates. Although the contractors from A.D. Little did weight and rate some of the size, weight, and cost trade-offs, the group grew impatient with that effort and ultimately considered the various maintainability and life-cycle costs on a more global level.

d. Measuring Success: They did not feel certain what the specific IPPD outcomes or milestones were. Their philosophy was to be aware of IPPD processes and do what you can, when you can, while concentrating on the main criteria of meeting project milestones and keeping customers involved and happy. In this project the use of IPPD techniques was not necessarily making the customers happy.

e. Observations: It seems this project, because of early involvement of consultants, recognition of need to employ IPPD, and contractors acceptance of IPPD requirements had a good start for IPPD. Use of IPT sessions involving potential users enabled managers to refine the requirements and develop an HOQ. However, the conflicting demands of users and the users' reluctance to patiently gather data and employ IPPD decision-making methods prevented

the optimum use of IPPD value analysis tools. IPPD training for user members of IPT and better skill among IPT members who had been trained (or more mentoring during IPT sessions) might have resulted in overcoming the resistance. The interviewees clearly indicated the mentoring support was essential until program personnel had enough experience with IPPD processes to facilitate their implementation at the IPT sessions.

The PM suggested the emphasis on increased communication with and involvement of customers on the IPT was a facet of IPPD that was very beneficial. It helped in requirements determination and in broadening the perspective of the contractors and other project planners.

Although the interviewees didn't point to specific examples of its use, the material covered in the DOE course was also reported to be highly regarded.

NGT (Next Generation Transparency) This project is developing a process for creating a frameless aircraft transparency (canopy/cockpit cover) by an injection molding process (versus the more expensive/heavier framed transparency apparatus on most aircraft).

a. Interviewees: The researcher met originally in August with Bob McCarty, the Program Manager, and three members of his team: Mike Waddell (Deputy PM), Mike Gran (Chief Engineer), and Russ Urzi (through-the-canopy technical specialist). Mike Gran had not been through the DSSM course but had taken the DOE course (and eventually the IPPD course). He felt he had enough experience with IPPD and with the program manager that he could provide meaningful input regarding implementation. Sixteen other members of the IPT took the DSSM course in May 1996, but were not available (because most were contractors) for interviews on that visit. They were sent Follow-up Questionnaires. Additional follow-up telephone interviews with Bob McCarty in December 1997 and April 1998 provided the updated status of the IPPD implementation in their project.

b. Appropriateness for IPPD: Although team members took the DSSM training in May 1996, the project funding was on hold until June 1997. Thus at the first interview, the project was just beginning and had the opportunity to demonstrate use of the IPPD process over the next two years. At that time, and at a later interview in December, McCarty felt this project had a fairly high likelihood of positive results because of several factors:

– Their branch (AFRL/VAVE-formerly WL/FIV) has employed similar processes for years in their other programs, determining their customers' requirements and doing cost/risk/performance tradeoffs.

– Technical proposals and the SOW under PRDA agreements explicitly state that subcontractors will embrace the AFRL model process desired by the government.

– Two years prior to committing of funds, system customers were already using these methods to assess risks (industry teams supporting JSF program and F-15 SPO were assessing risks for transitioning technology and considering trade-offs of cost, performance, and risks).

c. IPPD Organization/Activities: The PM indicates they have three IPT subteams, with both government and contractors on each. He and Mike Gran and the Boeing PM are the primary monitors of IPPD implementation, ensuring appropriate inputs from technical specialists such as Russ Urzi. Communication has been frequent, with weekly meetings and teleconferences to

discuss problems and report the status of each team, and with an active use Net meeting software to facilitate review of data and documents. They are transitioning to a secure web site and will be using web site databases, a process that Boeing has used successfully on other projects. With these methods, Boeing is able to lead a team of five scattered subcontractors and keep them enthused about the process.

In addition to original DSSM training in May 1996, the PM and six key IPT members took the IPPD training in September or October 1997 and six other members took either the DOE or Design to Cost training in 1997.

The project has extremely good interaction with and support from users/customers, including both Air Force commands and SPOs and potential civilian contractors who would employ the technology in automotive windshields. This cooperation is working well in these early stages as the customers helped the team identify areas of technical risk and define system requirements. They even reached a decision with the F-22 community to use the F-22 vehicle for demonstration purposes and are designing a dual-purpose tool for molding canopies for both F-22 drop-in and for JSF frameless technology maturation. Most of their activity has been part of the development of the HOQ. Although these initial definitions are subject to change, the technical or engineering requirements as well as the cost and producibility requirements have also been defined, and the initial exit criteria have been established. In addition, the team has worked on the identification of technology voids (the "roof of the House").

Although the IPPD process outlines six steps and the IPT has primarily worked on the definition of requirements phase, the PM suggests there are other IPPD considerations from different phases that are addressed in parallel rather than sequentially. For example, they've already been employing DOE processes to determine design criteria that will solve the crazing tendency under varying temperature, humidity, and load factors. They also have been thinking about Value Scorecard issues and identified key large investment items that will be potential show stoppers on the Scorecard at a later time. They're moving more fully into design analysis, using simulations to look at aspects such as the producibility of a canopy for F-22, optics, and bird-strike effects. They will be using technology worksheets for performance, supportability, and cost to document the results of their analyses and will roll up the data into a value scorecard.

d. Measuring success: Although the IPPD philosophy is evident in all the IPT's documents and briefings, and they plan to provide extensive training, they feel the real measure of success remains whether teams can demonstrate they based decisions on data gathered and analyzed

e. Observations: The team members seem to have bought into the general philosophy of IPPD, but application of procedures in this project is still an experiment. So far it seems to be going well, and its continued success may be affected by a number of factors

– The degree that vendors can become fully knowledgeable of the IPPD processes and their ability to collect data required to demonstrate use of those procedures in decision making. Boeing (a prime contractor) has employed these methods in their 777 project, but many other subcontractors are less experienced in the procedures needed to gather data and to measure factors needed for tradeoff decisions. A key seems to be whether government team members and prime contractors can hold subs' accountable and insist they (and perhaps help them learn how to) employ the data collection and statistical analysis procedures required to demonstrate IPPD was used in decision making

– The ability of the IPT members to obtain assistance and tools to help them in this effort. The PM indicates that James Gregory consultants have been key players, providing the IPT with decision making tools and an electronic version of the House of Quality and facilitating at meetings. Additional mentoring will be needed as they continue through some of the other steps and decisions.

OTH (Over The Horizon Radar). This project is wrapping up an 11-year effort to improve the ability to detect small low flying aircraft at great distances. They are working in conjunction with (for) the Navy.

a. Interviewees: The researcher met with Mitch Beyer, Doug Cameron, Lorraine Flanders, Don Harvey, and Greg Merrill in one group to discuss their efforts towards implementing IPPD. Additional discussions were initiated with the PM and Ms Flanders to review the status.

b. Appropriateness for IPPD: This project is 11 years old and in the last year of development. From the initial training, the group indicated it was too late to implement IPPD in their project. Almost all of the requirements decisions and design specifications had already been made. Additionally, this project was developing software, and the group could not figure out how to adapt the IPPD procedures to that process.

c. IPPD Organization/Activities: There has been no continuing formal plan for IPPD implementation. The group met with the training consultants once, immediately after the initial IPPD training, and they determined that IPPD technologies would not work on this type of software development, especially at such a late stage in the project. They do feel, however, that some IPPD techniques are valuable. They sent several of their members to additional IPPD-related courses: six to the DOE course, three to the Design to Cost session, and one to the DSSM course. For ten months there was little application of IPPD procedures. However, as the final report was being completed, the training consultants met with OTH representatives to try to develop affordability metrics to assess the relatively new Relocatable Over-the-Horizon Radar (ROTHR) technologies. They are exploring the potential of using desirability functions to characterize ROTHR metrics and provide a way to evaluate technologies with respect to a Customer Satisfaction Index (CSI).

d. Measuring Success: No efforts were made in this area since they did not utilize IPPD techniques.

e. Observations: The group liked IPPD and saw it as valuable. They just could not realize how to apply it to their project. They indicated the Navy also uses IPPD, so the group realizes there are some potential benefits; but due to the maturity of the research project, and the fact they were developing software, they determined it could not be applied. Only after additional consultation with the trainers and the development of additional metrics with other pilots are the OTH reps reconsidering the analysis of technologies in a manner more in line with the IPPD process. This is a good example of how the implementation of IPPD in the S&T environment is an ongoing learning process.

VIVIDS (Virtual Interactive Intelligent Tutoring System Development Shell): This IPT provides an opportunity to view the use of IPPD processes in a software design project. The intelligent tutoring (IT) shell is a technology that was initially developed in 1992/93 as part of a Simulation-Based Adaptive Training program to produce an authoring tool (software product) for embedding instruction in software simulations. The IT shell has been adapted for use in several training programs for various major commands. The laboratory also uses the technology in some of its own training programs. This VIVIDS IPPD project was initiated in March 1997 and involves both upgrading the authoring shell capabilities and applying the VIVIDS technology to Air Force Special Operations Command (AFSOC) and Air Education and Training Command (AETC) training projects.

a. Interviewees: The researcher met in a small group session at Brooks AFB with five of the nine IPT members who had taken the IPPD training at Texas Instruments in September 1997. These participants were Jim Fleming (PM), Winston Bennett, Terry Jackson, and Craig Hall (government members of the IPT), and Carol Horwitz representing Coherent Technologies, Inc.

b. Appropriateness for IPPD: As a typical reiterative software design process, this project is important because it can help determine the potential for using IPPD processes in a software research project. There is a definite customer, and the project was identified as a pilot, and initial IPPD planning began in May 1997, very soon after the project kicked off. However, the IPPD training did not take place until September 1997, after a number of decisions regarding functional specifications had already been made.

c. IPPD Organization/Activities: The key groups in the IPT seem to be (a) the AFRL research members who interact with potential customers to determine applicability of the VIVIDS tool to their training course needs, help outline user requirements, and test and evaluate the tool in the field; (b) the CTI contractor who develops the functional specifications for the software changes that must be made; and (c) the contractors at University of Southern California's Behavioral Technology Lab who actually make the software changes/enhancements. Because the CTI representative is on site at Brooks AFB, there is strong team coordination at the front end. Representatives from all three organizations attended the IPPD training session. In the first six months, there has been little post-training interaction with the James Gregory consultants. However, the IPT members and consultants are attempting to meet to discuss the ways in which the IPPD metrics can be translated to a software design process.

Because of the timing of the IPPD training, some initial actions were completed before the IPT members were knowledgeable about the IPPD processes. Major requirements had already been determined, initial decisions regarding functional specifications had been made, and two prototypes had already been determined. Customer requirements were outlined at TPIPTs and program review sessions. Although a House of Quality was not developed, the IPT members report using a Quality Function Deployment (QFD) process to outline, quantify, and weight (prioritize) functionality requirements.

Team members indicated they had been dealing with cost-risk analyses for years and that they had internalized the information from the IPPD process and could use that knowledge in informal decision processes. In development of the two prototype approaches, technology worksheets were not used, but some formal spreadsheeting of the functional requirements vs cost factors involved in many decisions was provided. These results are summarized in the documentation of the factors considered in these decisions. Team members suggested that the

customers don't always want to go through the detailed cost, risk, and requirements data at the beginning of the project and that the IPPD procedures might be more applicable during the evaluation of the prototypes.

d. Measuring Success: Although the concepts underlying the IPPD process (e.g. cost, risk, and performance tradeoffs) are discussed at review sessions, there has been no formal process for measuring IPPD implementation progress.

e. Observations: The fact that IPT members were not trained on IPPD until after a number of decisions had already been made had an obvious effect on implementation of early IPPD procedures such as the HOQ. There is a great degree of uncertainty about the appropriateness of applying the formal IPPD procedures in the course to this software engineering project. At this point it is seen as a less efficient, time-consuming process for the type of reiterative design enhancement efforts that are common to the software domain. This may be a case where additional collaboration with the James Gregory consultants would enable the IPT to learn how to adapt that process to their software projects. Or it may be that the consultants and IPT members will find the IPPD process is less useful for this type of S&T research. At this point (six months after initial training), the quandary is not resolved, but it is certainly worth the effort if the IPT can afford the time to help address the issue.

WINDS (Ballistic Winds - Gunship, Airdrop, Bombdrop): This project is to develop a lidar system that can measure wind profiles from an airborne platform to improve the operational effectiveness in gunship, airdrop, and bombdrop accuracy. Originally a prototype was successfully tested for gunship customers in May 1996, but that program was canceled, and the researchers were committed to demonstrating that the technology is applicable to airdrop and bombdrop, as well as commercial, purposes. At the time of the November interviews, there were no immediate customers committed. By April 1998, the bombdrop portion was on hold and only the airdrop program was active

a. Interviewees: Three key government members of the 15 original IPPD trainees still with the program were interviewed (five members of the original gunship team at Robins AFB are no longer working the project, and three contractors from CTI were not available). The members were John Carr (Airdrop PM), Everett Wood (Bombdrop PM), and James Root (Technical Lead for third generation transceiver development)

b. Appropriateness for IPPD: Prior to cancellation, the gunship effort seemed to have the components for effective IPPD decision making (technology, mission performance, and cost tradeoffs). Although the lack of identified customers has hindered the identification of specific requirements for air- and bombdrop efforts, questions associated with development of a third-generation transceiver for wind profiling and with the need to reduce technology transition costs seem to be appropriate for the IPPD process.

c. IPPD Organization/Activities: The contractor (CTI) is building the lidar system, and AFRL/SN team members are arranging the support components and testing on the airborne platform. Sverdrup is contracted to determine how to take the new WINDS data and apply it to the existing Computed Air Release Point drop algorithm; Raytheon did the C-130 fuel pod modification. Most communication among these members has been through telephone and electronic means. The team has received its third-generation equipment and will be conducting environmental and other tests in the lab. The goal was to demonstrate airdrop usability in a

March 1998 demonstration. However, technical delays have pushed that date to September 1998. Initial DSSM training was provided for AFRL air- and bombdrop team members in November 1996, and new IPPD training was attended by three CTI contractors in April 1997. James Gregory consultant support was provided to CTI in May 1997 in conducting a designed experiment.

Team members have met frequently with potential customers of the airdrop system, and the bombdrop members had met with an ACC liaison to show potential utility and to elicit customer needs and more specific requirements. The airdrop team has outlined general operational, technical, and affordability objectives and exit criteria. A technology transition plan has been built and coordinated with potential users, and MANTECH has been involved and has contributed funding to take the current third-generation configuration and improve aspects for manufacture. However, the team determined that IPPD process documentation, such as developing an HOQ, technology worksheets, and value scorecards, would be too demanding on limited time and resources for little potential benefit. Therefore, affordability and cost decisions were made intuitively rather than with those IPPD tools.

d. Measuring Success: The team has a prepared response to the "Affordability Pilot Program Scorecard," which shows they have an understanding of the major criteria for measuring success of an IPT program. The impression is that they are fulfilling some of the requirements outlined on the scorecard (e.g., some training has been provided, a transition plan has been developed, affordability/produceability issues have been identified).

e. Observations: It is clear that this IPT seems to embody the spirit of the affordability initiatives in its attempts to identify performance/cost tradeoffs that would make the system more attractive for military customers and enhance manufacturability for potential transition to civilian customers. There is a sincere belief, however, that the TDYs, manhours, and extra documentation and briefings associated with IPPD implementation are added costs and resource demands that are not reimbursed. They are not convinced that the hard part of the IPPD process implementation (data gathering and analysis and documentation for decision making) provides added value to make up for those additional costs.

CTI members reported they felt the DOE session was very worthwhile and was more beneficial than the IPPD session. John Carr suggested the DOE methods could be used in the experimental demonstration.